THE UNDER-REPORTING OF INJURIES FOR HISPANIC WORKERS IN CONSTRUCTION

by

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ABSTRACT

Using data from the Bureau of Labor Statistics and Current Population Survey, this work will examine under-reporting of nonfatal workplace injuries and illnesses in construction for Hispanics from 1976-2008 at the national level. Previous research implemented different methods and techniques to examine the reasons behind under-reporting of workplace injuries and illnesses, concluding that the current surveillance system suffers from a problem of chronic under-reporting. By focusing on Hispanics working in construction, and by using different methods to examine to what degree the presence of Hispanics at the worksite contributes to the under-reporting of nonfatal occupational injuries and illness, our findings suggest that the presence of Hispanic construction workers significantly reduces the number of reported injuries.

A lagged fixed effect model will be used to investigate the under-reporting issue in construction with regard to Hispanics. Usage of this model constituted the first departure from previous research that studied under-reporting in which capture-recapture and face-to-face interviews were used. The second departure was implementing this method in the construction industry. This is the first time a lagged fixed effect model has been used to study this phenomenon (under-reporting in construction), while most literature about under-reporting has been restricted to manufacturing with some covering the overall economy. Lastly, this work is different in its duration and scope: It covers the years from 1976 up to 2008 and includes all 50 states and the District of Columbia.

From a base model (without inclusion of Hispanics) we can see that the real workers' compensation rate negatively impacted all types of injury reporting except light-duty, while union rates, unemployment, wages, and firm size correlate negatively with all types of injuries. When Hispanics and their interactions with union rate and workers' compensation rates were included and summed as independent variables, we see that the presence of Hispanics leads to a decrease in the incident rate for all types of injuries except for light-duty. In other words, the presence of Hispanics leads to lower reporting and, therefore, the appearance of lower rates of all types of injury rates except for light duty which indicates that Hispanics are under-reported.

To my wife Nadira and my family

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LIST OF ABBREVIATIONS

BLS: Bureau of Labor Statistics

WC: Workers' Compensation

SOII: Survey of Occupational Injuries and Illnesses

OSHA: Occupational Safety and Health Administration

FTEW: Full Time Equivalent Worker

DIA: Denver International Airport

NAICS: North America Industry Classification System

SIC: Standard Industrial Classification

NCCI: National Council on Compensation Insurance

CHAPTER I

INTRODUCTION

While Hispanics are not actually safer construction workers when compared to others (we know this because Hispanic construction workers die at a higher rate than others), Hispanic workers do appear to be statistically safer than others given that a higher percentage or ratio of Hispanic workers to non-Hispanic ones have lower reported injury rates. However, where unionization rates are higher, reported Hispanic injury rates are higher, suggesting that unions either protect Hispanic workers' right to report injuries or that unions may select for legal Hispanic workers making them less susceptible to under-reporting. Emphasizing that our results capture under-reporting, we find that Hispanic workers are "safer" only where workers' compensation rates are higher. These facts taken in aggregate lead to the conclusion that Hispanic construction workers' injury rates are systematically under-reported where the cost of injuries are higher and union coverage is lower.

Under-reporting is one of the major problems facing the national surveillance systems that record injury and illnesses in all sectors of the economy. Under-reporting of injuries is a significant but difficult to measure problem in construction as well. This research provides insight into injury under-reporting in construction by focusing on the

reporting of injuries for Hispanic workers. Hispanic workers include a high proportion of immigrant workers, many of whom have limited English language skills and who may be constrained or hindered by illegal work status. Such persons, therefore, are among the construction workers most at risk for having their injuries go unreported—either due to the language barrier or fear of being deported or both.

To examine the under-reporting problem in construction using annual, state-level construction injury rates by construction subsector over a period of about 30 years, a lagged fixed effects model is used to regress overall and subset injury rates against a set of demographic, economic and labor market control variables. The association between these variables and injury rates is generally what was anticipated by previous research. These control variables, which include the construction unionization rate, account for 60% of the variation in overall construction injury rates. Controlling for these factors by introducing the percentage of Hispanics working in construction finds that the higher the percentage of Hispanics, the lower the reported injury rate. Controlling for both unionization and the percentage of Hispanics, I find that the interaction of unionization rate with Hispanic correlates with greater reported injury rates. This suggests that either unions select for less disadvantaged Hispanics (perhaps those who are legal to work in the United States and/or those who speak English), or that construction unions serve to directly support and encourage the reporting of injuries for Hispanic workers. While in some models the positive correlation between Hispanics and unionization is not statistically significant, I find that, having controlled for the workers' compensation rate an interaction obtains between the workers' compensation rate and the percentage of Hispanics is systematically negative and statistically insignificant. This indicates that

where the cost to the employer of injury rates is higher, reported Hispanic injury rates are lower. Under this formulation of the model, the interaction between the percent of Hispanics and unionization is positive and statistically insignificant. On the assumption that Hispanic workers are not safer than non-Hispanic workers, the results may be interpreted as the follows: 1) Hispanic worker injury rates are under-reported where the cost of injuries to the employer is higher, and 2) where union representation is lower. The assumption upon which these conclusions rest is supported by: 1) the fact that Hispanics have higher death rates in construction, where unlike injury rates, death rates are recorded according to ethnicity; and 2) it is implausible that Hispanic workers should be safer in situations where injury risks are greatest.

This research aimed to test my thesis that:

> Injuries for Hispanic workers in construction are under-reported in general with incidences of under-reporting being greater when and where workers' compensation costs are higher and, furthermore, that this under-reporting of Hispanic injuries is less when and where union representation is greater.

Under-reporting of injuries and illnesses is one of the major problems from which national surveillance systems and reporting mechanisms suffer. Additionally, there arises a related problem in determining how to measure it. The evidence compiled from academic research and the media proves that under-reporting is a major problem confronting both officials and researchers alike. As mentioned previously, academic research measuring under-reporting is relatively limited and also only very recent. The main conclusion of these studies is that under-reporting is a fact and the magnitude of the phenomenon ranges widely, as do the methods and techniques that have been used to

gather data. The research of Boden and Ozonoff (2008) concluded that the Bureau of Labor Statistics (BLS) surveys reported, at most, only 76% of all injuries in the states under consideration. While the study conducted by Rosenman et al. (2006) of Michigan concluded that the Survey of Occupational Injury and Illness (SOII) missed up to 68% of work related injuries and illnesses, Leigh, Marcin, and Miller (2004) argued that the SOII missed between 33 and 69% of all work-related injuries and illnesses. A real time example of the magnitude of under-reporting came from the construction of Denver International Airport (DIA), with a study documenting and comparing what was reported by the BLS in relation to the project and the actual number; and what they concluded was that the numbers and rates of injuries and illnesses are more than double those published by BLS (Glazner et al., 1998). Smith et al. (2005) concluded that injuries with days away from work are 1.8 times higher than BLS estimates. Workers' compensation programs are also not immune to under-reporting. Shannon and Lowe (2002) showed that, using Canadian survey data, that 40% of injured workers who are eligible did not file for workers' compensation.

Under-reporting phenomena can be caused by many factors, and one reason is the presence of less advantaged workers who fear being fired, disciplined or their coworkers losing rewards. From the standpoint of employers, the main reason for under-reporting of workplace related injuries and illnesses has to do with a fear of increasing workers' compensation costs to the diminishing of a given company's chances of winning contracts and bids. Explaining how under-reporting might occur, and why it does, is detailed by means of a conceptual filter model. Since reporting and documenting any work related injury or illness includes a complex series of steps, this model filters out any

accident that does not pass from one stage to the other, which makes it clear how under-reporting might transpire with certain injuries and illnesses being lost in the documentation process (Azaroff, Lax, Levenstein, & Wegman, 2004; Azaroff, Levenstein, & Wegman, 2002).

Once the under-reporting problem is recognized, tackling the other problem, another issue that has recently begun to attract interest of the academic community, is how to measure under-reporting. What renders issues more complicated is trying to measure to what extent the ethnic or racial factor contribute to under-reporting in an industry dominated by less advantaged workers, and, in this work, we are focusing on the Hispanic element in relation to under-reporting in construction. By its nature, construction is one of the most hazardous industries and occupations in term of workplace fatalities and injuries. According to the latest report by the BLS (2010d) nonfatal occupational injury and illnesses rates declined in 2009 to 3.6 cases per 100 full time equivalent workers (FTEW) from 3.9 cases in 2008, which in actual numbers means it declined from 3.7 million in 2008 to 3.3 million cases in 2009. For construction, occupational injury and illnesses cases declined in 2009 to 4.3 cases per 100 full time equivalent workers (FTEW), a rate that is still clearly above the overall national average. One the other hand, the BLS reported that fatal occupational injuries for 2009 were 4,340 cases in the private industry sector as compared to 5,214 cases in 2008, where the construction sector had the highest number of cases with 816 or about 19% of the total.

The driving force behind the recent interest in quantifying under-reporting came as an attempt to explain and understand the trend of declining workplace injuries and illnesses in different sectors of the economy. According to the officials of the BLS and

other major surveillance systems, the declining trend witnessed in workplace injuries and illnesses is due to the increase in safety regulations and higher standards, while some researchers attribute the decline to improved record-keeping implemented by Occupational Safety and Health Administration (OSHA) agencies. For example, Friedman and Forst (2007) claimed that between 1992 and 2003 the decline in injuries and illnesses was occurring after changes in OSHA record-keeping in 1995 and 2001, respectively. Friedman and Forst (2007) concluded that about 83% of the decline could be attributed to the changes in OSHA tabulation. There is little doubt that over time workplace safety did improve and that standards were implemented more aggressively, but can the decline only be explained through and attributed to better safety measures and standards in addition to more precise recordkeeping?

Since the 1970s, many studies have been conducted in order to predict injury rates across the various sectors of the economy. Differently stated, these have sought to ascertain what factors influence or determine injury rates in the economy. Most of this research, and at the same time much of the debate, was centered on the relation between workers' compensation and injuries and the question of a negative or positive correlation between them. Other control variables are of interest such as demographic factors (ethnicity, age, education, gender) as well as market variables (unemployment, unions, wages) and industry factors (firm size, hours worked), but the most significant or conspicuous among these variables is that of workers' compensation. Much of the aforementioned research focused on the manufacturing industry and mining while other industries were ignored.

The frequently studied relation between workers' compensation as determinant of injuries and illnesses comes from the fact that with any type of insurance, a moral hazard issue will come into play and the behavior of an ideal and perfectly competitive market in providing an efficient solution will be in vain. The debate intensifies when it comes to separating the reporting effect from the safety effect (wages provide a good indicator of the safety effect) of workers' compensation. Thus, the presence of workers' compensation will not only affect workers' incentives (through providing benefits), but it will also be expected to affect employer's incentives (through safety). On the surface, these two goals seems to be contradictory, where the greater the workers' compensation benefits are the higher the injury rate would be (Butler, 1983; Butler & Worrall, 1983; Chelius, 1974; Ruser, 1985). The safety effect of the workers' compensation relation depends on the degree of experience rating of the firm, and typically, the larger the firm the higher its experience rating is. What this means is that in bigger firms, the presence of the workers' compensation safety effect will dominate and injury rates will be less (McVittie, Baniken, & Brocklebank, 1997; Ruser, 1985, 1991).

The evidence is overwhelming for the existence of under-reporting of injuries and illnesses in the national surveillance systems. Individual and industrial characteristics are among the reasons behind this phenomenon. However, there are some industries with certain features that will suffer more than others from under-reporting, as is the case with construction.

Construction has very unique characteristics that make it more susceptible to the problem of under-reporting of injuries and illnesses. That is, construction as an industry is highly fragmented and characterized by firms of radically different scale. In other

words, some projects are handled by giant construction companies with hundreds of workers; and, conversely, other construction projects are undertaken by companies employing as few as two or three workers at the most. According to the Bureau of Labor Statistics, the U.S. Department of Labor (BLS, 2010a) reports that in 2008 the construction industry employed 7.2 million workers in salary and wage jobs with 1.8 million workers being self-employed or working for family members, and, during the same year, there were 884,300 establishments in the nation with about 68% employing less than five workers.

Construction is one of the most dangerous industries in the economy because of its nature. According to the latest report by the BLS (2010d) nonfatal occupational injury and illnesses rates for all industries declined in 2009 to 3.6 cases per 100 full time equivalent workers (FTEW) from 3.9 cases in 2008; in numbers this means it declined from 3.7 million in 2008 to 3.3 million cases in 2009. For construction, occupational injury and illnesses rates declined in 2009 to 4.3 per 100 full time equivalent workers from 4.7 in 2008. It is clear that it is still above the overall national average. At the same time, injuries with job restrictions or transfers are increasing over time for all industries as well as for construction (BLS, 2010d). One the other side, BLS reported occupational fatal injury for 2009 was 4,340 cases in the private industry sector (compared to 5,214 cases in 2008) where construction has the highest number of cases with 816 cases, or about 19% (BLS, 2010b). The data show that over time, the rate of total cases of nonfatal injuries and illnesses in construction per 100 full time equivalent workers is declining and higher than the rate per 100 full time equivalent workers for all industries for all years. For example, in 2007 the rate was 5.4 and 4.2, respectively; it is also true for injuries and

illnesses resulting in days away from work, 1.9 and 1.2. Given the previous trends for construction compared to all industries, injuries and illnesses with job transfer or restriction (light duty) are increasing for construction as well as for all industries over time.

As is known, Hispanic workers in construction can be said to be over represented when compared to other minority groups, and, they tend to be more likely to be employed in jobs that are comparatively more dangerous, requiring less-skilled work, and with poor work conditions (Menzel & Gutierrez, 2010; Pransky et al., 2002). At the same time, they are covered less than others by health insurance (McCollister et al., 2010), while suffering higher rates of fatal- and nonfatal occupational injuries than any other ethnic group (Dong, Men, & Ringen, 2010; Dong & Platner, 2004). Given that Hispanics are more often exposed to dangerous jobs and at the same time disadvantaged politically, economically, and culturally, the chances of reporting any related occupational injuries and illnesses will be small. Azaroff et al. (2002, 2004) developed a filtering system of how many injuries will never be reported by injured Hispanic workers. Their injury model explains obstacles to documenting workplace injuries and illnesses to the BLS, workers' compensation, and medical database and shows the steps and channels each injury has to go through before being documented and recorded by each of these systems.

Hispanic representation in construction is increasing rapidly over time as a percentage of all construction workers; Hispanic workers increased from 9% in 1990 to 24.7% in 2008; this represents an increase of 174% (BLS, 2010c). These trends in nonfatal injuries and illnesses in all industries in general, and in construction in particular, attract the attention of researchers for their puzzling nature, meaning that some

trends—such as total injuries—are apparently decreasing, while others are increasing, such as injuries with job transfers or restrictions.

These numbers provide a clear indication of how severe the problem of under-reporting is in general, and in construction in particular, given the typical composition of the construction work force where the death rate for Hispanics is higher than the national average, while at the same time rates for most injury types are declining except for light-duty. This potentially represents a clever way of disguising under-reporting especially for vulnerable workers like Hispanics.

In this research, the focus is on predicting under-reporting for injuries and illnesses in construction in relation to Hispanics and to determine—after controlling for numerous factors—how much the factor of the presence of Hispanics in the workforce contributes to under-reporting in construction.

After implementing a lagged fixed effect model to the panel data set, the results were as expected and support my hypothesis. At the same time the findings are consistent with other empirical work that has studied the relation between predicting injury rates and different control variables. From the basic model (that predicts injury rates without the Hispanic variable or its interaction variables) we see that it can account for approximately 50% of injury rate variation of all injury types except for light-duty.

The second major finding is the main focus of this dissertation, namely, the Hispanic factor as it correlates with injury under-reporting. After introducing the percentage of Hispanics and their interaction with union rates and real workers' compensation rates, I found in all cases except light-duty that the higher the Hispanic

presence in the industry (construction) the fewer the reported injuries for all types of injuries and the more that light-duty jobs were assigned for injured workers.

This dissertation consists of six chapters. Chapter II undertakes a review of the literature about workers' compensation history, calculation, and some empirical work related to injury determination and workers' compensation. Chapter III covers under-reporting of injuries and illnesses and Hispanic fatal and nonfatal injuries in construction. Chapter IV furnishes the data and model used, and Chapter V examines the results of this research in detail with Chapter VI providing the conclusion and summary.

CHAPTER II

LITERATURE REVIEW

Nonfatal Occupational Injuries and Illnesses Trends

Given the nature of any job, there is always some degree of potential injury risk associated with it, where the more the hazardous a given job is the higher the risk of suffering an injury is in the course of work. Work-related injuries and illnesses may be seen as byproducts or externalities of economic activity that can be either random or deterministic. Put another way, employees and employers share control over events and both are affected by the consequences. In the past 4 decades, the overall rate of work-related injuries and illnesses in the United States has steadily declined, with a few exceptions. Work-related injuries and illnesses that required a job transfer or subsequent restrictions, and some minor interruptions of this overall trend, are the only irregularities in this overall trajectory. The national monitoring and oversight agency, the Bureau of Labor Statistics (2010d), found that the rate of nonfatal injuries and illnesses incidents among private industry employers in 2007 was 4.2 cases per 100 full time equivalent workers, a decline from 4.4 cases in 2006. Figure 1 shows data for the incident rate of work-related injuries and illnesses from 1972 onwards. According to this information, the rate in 1972 was 11 cases per 100 full time equivalent workers, compared to 3.9 cases in 2008 (BLS).

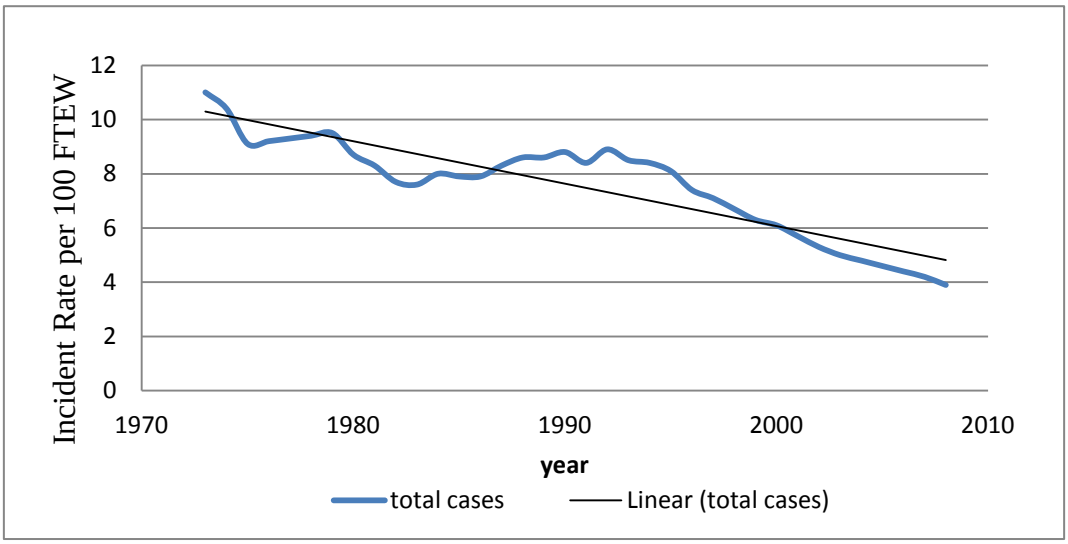

Figure 1. Work related injuries and illnesses total cases rates-all industries.

Generally speaking, a similar trend can be found in many other occupations and industries across the country. For example, Figure 2 shows that the incident rate for the construction sector in 2008 was 4.7 cases per 100 full time equivalent workers, representing a decline of 2.4 cases and 8.4 cases for 2002 and 1992, respectively. A similar trend also can be found in manufacturing, mining and agriculture, where in 2008 the incident rate was 5 cases per 100 full time equivalent workers, compared to 12.5 cases in 1992.

The same trend does not hold for the occupational injuries and illnesses that required job transfer or the implementation of postinjury restrictions (such as specification of light-duty), where the overall trend in almost all industries is sloping upward. Figure 3 depicts the above claim of increasing injuries and illnesses case that require job transfer or restrictions (light duty).

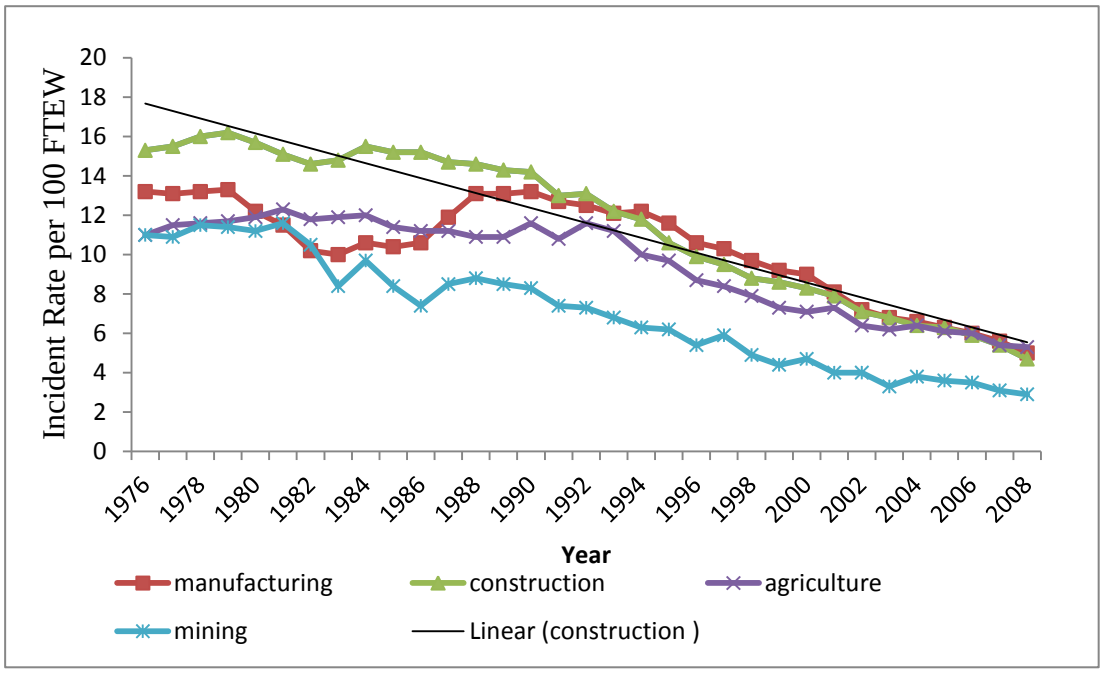

Figure 2. Total cases of injuries and illnesses for selected industries.

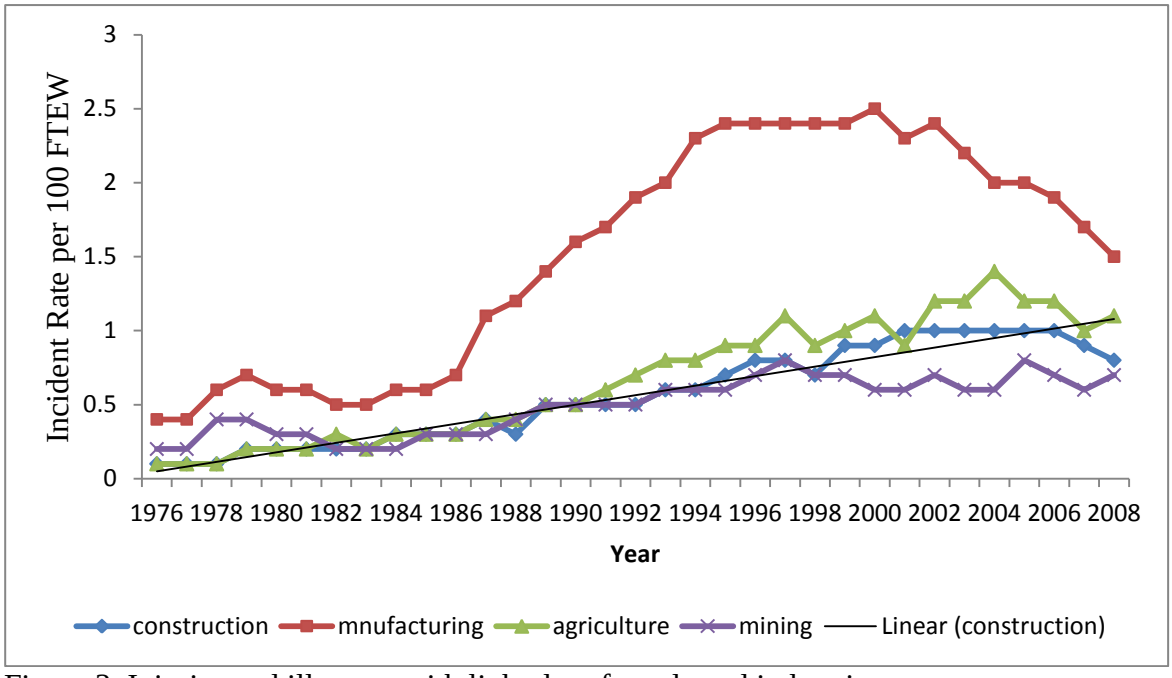

Figure 3. Injuries and illnesses with light duty for selected industries.

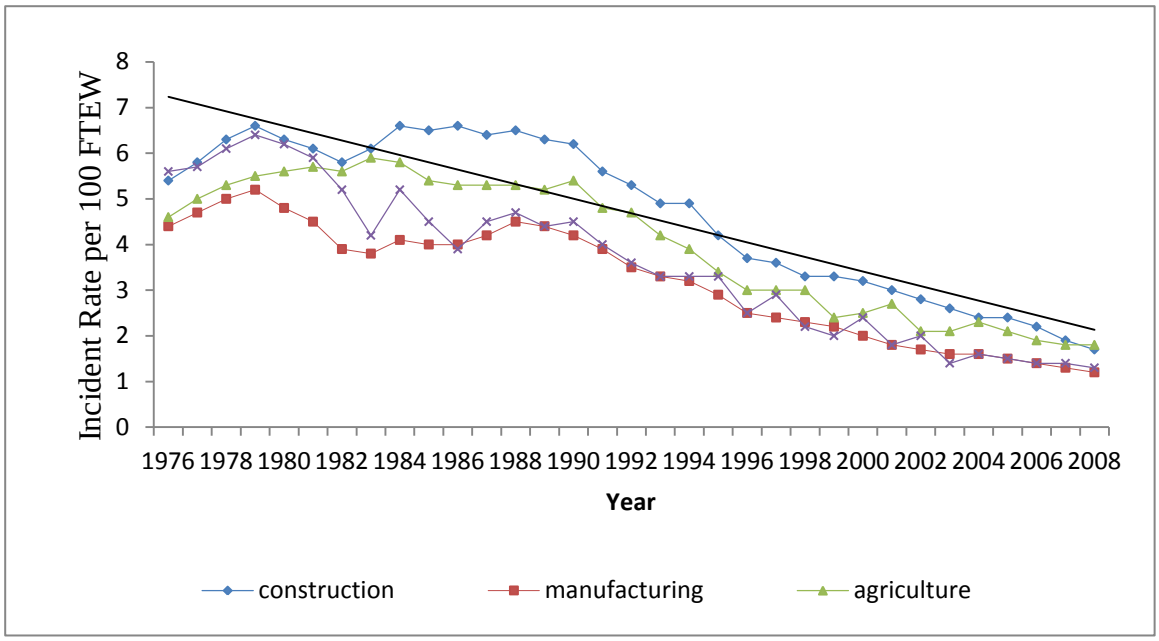

Figure 4. Cases with days away from work for selected industries.

On the other hand, Figure 4 shows the number of days away from work for selected industries where the trend has been declining since 1976, which means that this decline in injuries that result in days away from work has been absorbed by the cases with light duty. Figure 3 shows the increasing cases of light duty or job transfer. Figure 5 provides a clear picture about the different types of injury and illnesses reported in the construction industry over time. The rates of all types of injuries, except those leading to light duty, declined.

Before proceeding further, one important point about BLS data needs to be mentioned (and is further clarified below). One must keep in mind the different benchmarks and categories employed. In 2002, the BLS adopted the North American Industry Classification System (NAICS), while previously, the dominant system was the Standard Industrial Classification (SIC). Because of these differences, attention should be paid to the compatibility of data gathered under the two systems.

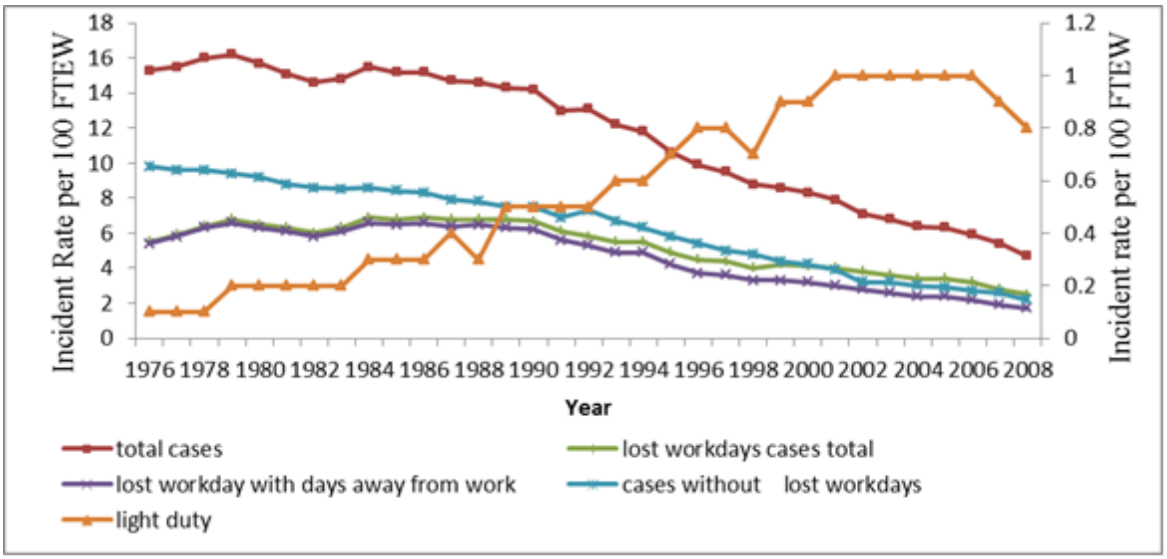

Figure 5. Construction injuries and illnesses incident rate trends.

This phenomenon of steadily declining incident rates has attracted the notice of numerous economists and policy makers seeking to explain and confirm the data. This literature focuses on the theoretical and empirical work related to explanation, while works centered on the confirmation or conformity issue are mentioned only briefly.

What explains the incident rate trend? What are the factors driving this trajectory? Stated differently, it is uncertain if the incident trend rate is the cause behind related factors, or if it is instead the effect of other forces, or perhaps it is both cause and effect. The answer to this question is found in analyzing the practice of under-reporting and the presence of Hispanics in the workforce. These two elements taken together are the key factors in explaining the overall increasing trend in injuries that required job transfer or restrictions (light duty). There is a very substantial body of literature devoted to trying to explain the declining trend of occupational injuries and illnesses over time. Many works also explore how workers' compensation rates, that at one time were based on a given firm's experience rating, can somewhat explain this trend. Demographic,

economic, and market factors are also introduced in an attempt to clarify any impact they may have on that matter. Recognition that under-reporting is a major problem, one that plagues national surveillance system organizations and monitoring, is not a new insight. Many have also perceived under-reporting's role as a driving force behind the decline in reported occupational injuries and illnesses in a wide array of industries. Scholars have only recently attempted to quantify under-reporting as a major factor in this apparent decline in the total number of injuries and illnesses in almost all industries. The new approach was born from a belief that improved safety and standards do not seem to account for the apparent decline in injuries given the fact that reported fatalities increased, and in the case of construction, the job has remained a dangerous one.

Economic Theory

Nearly every job carries the potential for injury, though of course, some jobs are inherently more dangerous than others. Work-related injuries and illnesses may be seen as byproducts or externalities of economic activity that can be either random or deterministic. Put another way, employees and employers share control over events and both are affected by the consequences. Seemingly random in the particular, one may still predict the likelihood of an injury in general. We may, therefore, assign a risk level to an injury, and use the event's probability to make predictions and improvements to decrease the likelihood of an accident.

Both employers and employees can take steps to reduce workplace injuries. To name only a few examples: Improved technology, protective equipment, and safety training may all reduce the risk of injury. Even after every precaution, accidents are

perhaps inevitable. While laudable, the goal of an injury-proof workplace is an impossible dream.

Accidents are costly for all involved. For the employee, the cost may be tangible: the loss of income as a result of missed work days (lost wages), and perhaps medical and rehabilitation expenses, especially if complications develop. For some, chronic pain and suffering may linger long after visible wounds have faded. Other consequences are intangible, including abiding anxiety over possible future injuries. On the other hand, an injury will cost the employer through interruption and delay of the production process, damage to equipment and material, and the need to search for a replacement worker. Thus, given the costly consequences of an accident, and given that some degree of risk is inherent in any job, many turn to insurance policies to offset the expense of accidents. Employers often invest in one of the oldest forms of social insurance in existence: workers' compensation.

The economic rationale for government control of compensation system stems from the idea that the private markets—including the labor market—fail to provide optimal levels of safety, protection, and income security in the case of injury accident. Evidence abounds to support this contention. Among the reasons underlying this failure of the private market is that decision makers do not have complete information about the product they are going to buy (information about the risk of being injured in the course of work), and so wage differentials (such as those provided for riskier jobs) do not *ex ante* fully compensate the workers for the danger they encounter. For this reason, since he is not fully compensated for the riskier job, a worker will have fewer incentives to be careful, and in addition, they will not be adequately insured. In other words, if the worker

in a risky job is not compensated by higher wages, they will not be careful simply because of the danger of sustaining an injury. If, however, the risky job compensates workers, they will be more cautious because of the higher financial cost that missed work entails. Moral hazard and adverse selection are other reasons for the failure of the private market to provide insurance to workers.

Risk-averse workers face an economic decision of whether or not to take a particular job that unavoidably entails some probability of injury. A worker's preference can be modeled by using Expected Utility Theory. John von Neumann and Oskar Morgenstern developed this theory in the 1940s. Economists employ utility theory to model rational human behavior about decision-making. But if certain conditions persist or apply (axioms), the utility theory will not function properly unless certain axioms are met. The expected utility theory simply states that a rational human or rational decision maker facing risky events usually chooses between them on the basis of comparing expected utility in the case of each.

The idea of rational decision maker (making the best decision given information available to them) is not fully accepted by many scholars simply because the condition of full or complete information is not satisfied. Critics contend that rational choices by a decision maker are not possible—due to this lack of information. The evidence from psychology is overwhelming in suggesting that people do not behave based on the standard economic theory assumptions, but rather that they are prone to systematic errors in judgment, where behavioral economic theory is better suited to deal with these flaws (Dickens, 1985).

Because injuries are costly to both employer and employee, preventing and protecting against injuries—or *safety*—is of interest for all parties, including policy makers. Averting danger, while desirable, requires the allocation of resources that would otherwise be used or earmarked for other beneficial purposes (Chelius, 1974). This investment in injuries prevention (safety) can be both socially and privately efficient when total costs are minimized—where the marginal cost of injury prevention equals the marginal benefit. This gives rise to a situation where the safer the workplace, the more attractive it is to the worker. In the case of workplaces that are deemed more dangerous by workers the only way for a firm to attract workers is to increase wages, in other words, offer compensatory wage differentials correlated to the probability of an accident cost. However, most assumptions of economic models, such as the assumption of full information about the probability of injury or a frictionless market, are not met so the idea of compensating wage differentials to reflect the full cost of probability of an injury is questionable (Thomason, 2005).

Krueger (1989) modeled safety incentives for both employer and employee in a static model. Both parties are presented as rational decision makers who maximize any expected utility function in an attempt to quantify the rate of injuries, and evaluate to what extent injuries are impacted by the workers' compensation system as a proxy for safety, i.e., for a lower probability of injury. Viscusi and Moore (1987) used the expected utility model to study the trade-off between wages and workers' compensation. Ruser (1985) also adopted the idea of workers being risk-averse and their maximization of their expected utility of income, when he examined the relation between the increase in workers' compensation benefits and injury rates.

No treatment of the empirical and theoretical literature would be complete without a discussion of the first compulsory social insurance program, workers' compensation. This is because of the reciprocal relation between injuries and workers' compensation, and the direction of causality between them, has divided researchers between skeptics and supporters of the relation's existence.

The History of Workers' Compensation

The introduction of the workers' compensation program was one of the major achievements at the beginning of the 20th century during what came to be known as the Progressive Era that roughly spanned the period from 1910 to 1920. It was, and remains, perhaps the most progressive, extensive, and wide-spread social program in American history. It changed the nature and the dynamics of the workplace, and established the basis for later reforms including unemployment insurance, Medicare, and Social Security. To obtain a better understanding of the beginning of the workers' compensation program, it is important to understand the tort system it replaced, and to review the history of the era in which it originated.

Workers' compensation emerged as a channel through which employer and employee costs and the financial burden of injuries could be processed, in a way that engendered safer work environments and less costly workplaces. The first compensation law was adopted by 11 states in 1911, and it covered only workplace injuries, because they were more common than workplace diseases. By 1917, California and Massachusetts compensated for workplace disease; however, it was not until 1976, nearly 60 years later, that the remaining states compensated work-related diseases (Fishback & Kantor, 2006)

Before workers' compensation laws were implemented, an injured worker's only legal recourse was to bring a tort or a negligence suit against an employer. Winning such a suit, however, was very rare. A worker not only had to prove that the injury was not the result of his own negligence, but had to surmount three major rules weighted strongly in the favor of an employer as the defense in a trial. Additional weapons used by employers against litigiously inclined injured workers required the employee to prove that the injury had not occurred as a result of: 1) negligence of fellow servants or employees; 2) the knowing assumption or presumption of potential risk by employees; and 3) contributing, if not complete, negligence on the part of the injured worker or workers (Chelius, 1977). Medical payments and lost wages already placed a tremendous financial burden on injured workers, and those seeking legal recourse could be certain only of added expenses. The worker assumed the financial burden of taking the tort case to court, even when vindicated by the ruling.

The workers' compensation system was intended to overcome the shortcomings of the tort or "negligence" system approach. Workers' compensation provided cash benefits and medical and rehabilitation expenses for those suffering from work-related injuries or illnesses, regardless of who was at fault. In return, the employer's liability was limited. A worker, once compensated, surrendered his right to sue his employer. The legal philosophy that prevailed at the inception of the workers' compensation system had a lasting influence on the program. For instance, each state has its own compensation laws because of the prevailing legal opinions of the time. The United States Supreme Court's interpretation of the Constitution's Commerce Clause curbed Congress's ability to regulate matters not directly involved in interstate commerce. Thus, the federal

government was responsible for providing workers' compensation for interstate commerce including the transportation industry (railroad), and its own employees. On the other hand, because private, state, and local government workers were not covered by the federal insurance, their insurance was the responsibility of the states. States found that they needed to enact suitable statutes (Burton, 2007).

As mentioned, the workers' compensation system is a state-level, no-fault, compulsory system in most states except Texas. The system's primary purpose is covering medical and rehabilitation costs, and providing partial compensation for wages lost wages as the result of an injury. An added intent of the program is to internalize costs of injuries and illnesses. This will, theoretically, motivate employers to improve safety and health standards. Another objective is to spread costs by risk-sharing through insurance pooling. Most states usually compensate two-thirds of previous wages, based on state wage average bounded by maximum and minimum caps. A standard practice is to cover all medical costs, after a waiting period of between 3 to 7 days.

It is the responsibility of the employer to provide benefits to employees, and there are three different mechanisms through which an employer may provide these benefits: 1) by purchasing insurance from the state; 2) by purchasing insurance from a private carrier; or 3) by being self-insured. Different states have different insurance arrangements. Nineteen states, including Utah, Arizona, and California, make available all three approaches in a scheme known as a "competitive state fund." Five states, including Ohio and Washington, operate under systems of state-funded insurance, where private insurance is prohibited. This type of scheme is known as the "monopolistic state fund," even though three of the states that utilize this system do permit employer self-insurance.

Finally, the remaining 27 states, and the District of Columbia, allow employers to purchase insurance from private carriers or to self-insure (Burton, 2007).

There are different types of cash benefits provided by the workers' compensation program to injured or diseased workers. Claims can be categorized as follows: 1) Temporary Total Disability Benefits (TTD); 2) Uncompensated Medical Expenses; 3) Permanent Partial Disability Benefits (PPD); 4) Permanent Total Disability Benefits (PTD); and 5) Death Benefits. Cash benefits in all states are not subject to either state or federal tax, and there is also wide variance among states on issues of maximum weekly benefits as well as the duration of benefits payments (Worrall & Appel, 1985).

These indemnity incentives affect workers and employers in different ways. For workers, these benefits decrease the cost of injury. Ignoring any presumed desire for personal safety, workers may exhibit decreased vigilance, a phenomenon known as a "risk-bearing moral hazard." The other side of the equation is that given the generosity of workers' compensation benefits, the likelihood of workers filing more claims (whether real or fraudulent) will increase, and this is known in the literature as a "claim-reporting moral hazard." Thus, given that it reduces the cost of workplace injury, we can expect the wage differential to decrease as well, yet this is an empirical issue that needs to be evaluated. The question of how workers' compensation affects employer's incentives regarding workplace safety reduces, at least partially, to the question of the correlation between workers' compensation cost premiums and benefits.

The way premiums (insurance pricing) are calculated has changed since they were introduced in 1911. For decades after, insurance pricing was highly regulated and an administrative pricing approach was used. All that began to change in the 1980s. A wave

of deregulation swept over many sectors of the economy, including the workers' compensation program. Since then, the administrative pricing approach is no longer the dominant one in the United States. It is informative to look at how premiums were formerly calculated under the administrative pricing approach.

This approach is based on several steps. In each state a rating organization, usually the National Council of Compensation Insurance (NCCI), was set up. The body was tasked with providing an industrial and occupational insurance classification system, a system broad enough to encompass any industry. This organization collected information from private carriers about benefits and premiums within the state. The council used these data to establish pure premiums for each industrial classification which covered cash benefits, medical expenses, and loss-adjustment expenses. Pure premiums were then increased by a loading factor (accounting for commissions, profits, and administrative expenses) to produce manual rates for each classification. For states utilizing a manual rating, the loading factor is approximately 35 to 40% of the manual rating, and typically the manual rating is expressed as a dollar amount per $100 payroll. These findings still required the approval of the state insurance commissioner (Thomason, Schmidle, & Burton, 2000).

The amount paid by the worker is not always the product of manual rates multiplied by the payroll because of modification factors such as the experience rating for large- and medium-sized firms based on their previous work record and premium discounts for large firms with an annual premium over or above a specified amount. Another feature of this system was that most carriers paid dividends to stockholders

based on their underwriting experience, which was usually paid at the end of the policy period.

Under this scheme, because each carrier must begin a given policy period with the same manual rates, the chances for competition between different carriers at the beginning of a policy period was impossible. Deregulation of the insurance market brought with it a new flexibility regarding the manual rate. The change enabled private carriers to compete with one another, right from the outset of a given policy period. Additionally, many states have allowed competitive rating, deviation, and schedule rating as other forms of deregulation (Burton, 2007).

One of the major reforms of the workers' compensation program came in the wake of the 1972 Report of the National Commission on State Workmen's Compensation Laws. Representatives from industry, labor, state and federal government investigated the status of the various compensation programs in every state. Based on the findings of this committee and concern over deteriorating workplace safety, nineteen essential reforms or changes were recommended. Many states followed the commission's recommendations wherever they expanded, changed, and improved their programs in accordance with the recommendations that could be generalized as ones increasing the coverage benefits in kind and in volume for all workers.

The changes increased benefits to workers and employers' expenses. Between 1972 and 1979, cash benefits increased from 39.6% to 50.4%, and benefits as a percentage of payrolls increased from 0.67% to 1.01%. Simultaneously, employer cost increased from 1.11% to 1.95% during the same period as an indication of state compliance with the recommendations of the commission (Thomason et al., 2000).

Developments during the 1980s and early 1990s paved the way for later reforms. For a brief time in the 1980s, workers' compensation costs were low, but this soon changed. Workers' compensation costs, beginning in the mid-1980s, rose on average 11.9% per annum / per state. Costs increased from 1.66 as a percentage of payrolls in 1984, to 2.16 in 1991. The same trend can be found in benefits, where they increased from $18 billion in 1984 to $40.8 billion in 1991, which represents an average annual increase of 12.4%. Medical care costs during these years also increased, following the same trend.

These developments during the 1980s and early 1990s were fueled by employer concerns over increasing compensation costs and benefits, which subsequently led to another wave of reform that pervaded the 1990s. The main features of the 1990s reforms undertaken by many states aimed to overturn the changes of the previous decade. These changes sought to contain costs and benefits—after these had been liberalized during the previous decade. Medical costs, which had skyrocketed during the previous decade, were specifically targeted under the new regulations. The developments in the latter half of the 1990s can be summarized as follows:

1. Reduction in the statuary level of cash benefits that took place in some states, especially with regard to Permanent Partial Disability (PPD).
2. Changing rules of compensability (with more restrictive rules governing benefit-eligibility).
3. Transformation of the health care system and the introduction of managed care.
4. The rise of disability managements.

5. Remedy doctrine (workers' compensation benefit program) was exclusively challenged by courts because of the increased limitations on the availability of benefits (Spieler & Burton, 1998).

Costs and benefits declined during the same period, perhaps as a result of declining rate of injuries and illnesses. The labor market's expansion, where economic growth reduced national unemployment rates substantially, is another key factor in the diminishment of costs and benefits (Thomason et al., 2000). As a result of these developments (reforms), the cost of workers' compensation as a percentage of payrolls declined from 1.66 in 1992, to 1.08% in 1998.

Empirical Work

After this brief history of workers' compensation it is important to see how this was incorporated into economic theory and how it was modeled so that empirical work can be conducted and the theory's validity can be tested. Figure 6 shows the trends in workers' compensation (WC) rate (measured per $100 payroll) and the rate of total cases of injuries and illnesses per 100 full time equivalent workers (FTEW) in construction during the period from 1976 to 2008. Tracking the rate of injury and illness and workers' compensation rate over time was the focus of a huge amount of research. Empirical and theoretical work has been done in attempts to investigate whether changes in workers' compensation rates will influence changes in injury rates.

Most of this work focused on workers' compensation as the decisive variable in explaining changes in injury rates and other trends. Some supported the positive relation between workers' compensation and injuries, while other researchers supported the idea of a negative correlation between the two.

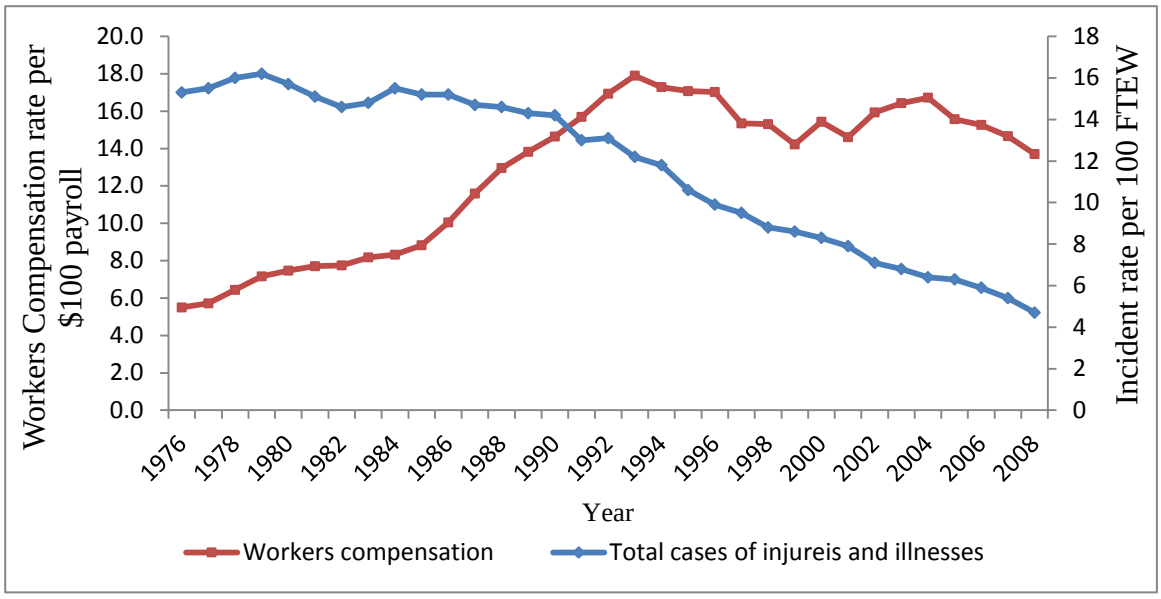

Figure 6. Workers' compensation and injury and illnesses rate in construction.

Theoretically, the analysis of the impact of change in workers' compensation cost and benefits and the rate of workplace-related injuries can be modeled by resort to neoclassical economic theory where the laissez faire principle is at the crux. Neoclassical economic theory envisions a perfectly competitive labor market where workers have full information about risk of employment and costs of accidents for each job, and also a system where workers are free to move between jobs. Given that they are rational decision makers, workers are assumed to seek to maximize utility. In this idealized model, because workers are supposedly free to move between hazardous and nonhazardous jobs, an employer who exposes employees to hazards must pay higher wages to attract workers. Potential hazards are thus offset by lucrative incentives. In other words, if we are assuming that workers positively value their expected earnings and view negatively the probability of being injured in certain jobs, we would expect that workers' movement between jobs would be based on an optimal combination of earning (wage rate) versus risk of a sort that would maximize their utility (wellbeing). Furthermore, if

all workers have the same preference, firms offering employment with a higher risk of being injured can be expected to pay higher wages than those offering lower-risk jobs. In turn, this means that mobility between jobs will lead to a wage differential that is fully compensated (Burton & Chelius, 1997; Ehrenberg, 1988).

One the other side of the equation, employers and firms will be expected to make choices according to what they perceive to be in their best interest. Some may opt for the wage rate-risk combination of injuries, or they may invest in safety to the point where the marginal cost of injury reduction (which includes recourses devoted to accident prevention) equals the marginal benefit of the injury reduction (including lower wages, reduction of lost production time, less training and reduced hiring new worker). In other words, in this model, equilibrium can theoretically be reached through investment and allocation of recourses where marginal expenditure on safety equals the marginal reduction in risk from this investment.

Given this theoretical framework, if the workers' compensation premium is calculated based on perfect experience ratings, or in other words, if the premium is based on the firm's past history of claims rather than a manual rating, then:

> …it would not affect the injury rate at any firm. Rather, because workers' compensation benefits would now compensate workers if they were injured, smaller compensation wage differentials would be required to attract workers to firms with high injury rates. Thus higher workers' compensation benefits should lead to lower wages at each firm. Workers' compensation benefits would not affect the injury rate that was optimal from each firms' perspective, since the reduction in wage costs would be offset by the new workers' compensation costs. (Ehrenberg, 1988, p. 75)

In other words, "under fully experience rated employer [must] bear the full cost of accidents, either in the form of ex ante wage premium or in the form of ex post compensation benefits" (Thomason & Burton, 1993, p. s7). In this idealized world (the

employer fully responsible for the accident costs) accident rate prevention motivations by both workers and employers will lead to contradictory results under different insurance arrangements. Because the employer is fully responsible for compensating workers in case of injury, and because wage differentials in such an event are not fully compensated, the marginal cost of any accident rate will increase in tandem with workers' compensation benefits. An employer would therefore have more incentive to allocate added resources to prevent accidents, so that injury rates will decrease. These expenses would be a reasonable investment, because higher benefits would be offset by lower wages. Because the employer is fully responsible for injury costs, the motivation to prevent injuries will increase so that the injury rate would likely decline.

However, firms are not all perfectly experience-rated; some are manually-rated. One must therefore consider how this theory will deal with firms that are incorrectly rated.

Since firms are not perfectly experience-rated, they are not fully responsible for bearing the full cost of ex post compensation, because premiums (costs) are determined in part by the accident rate of all the firms of the same industrial classification, so that each firm exerts a marginal effect on the cost of the insurance rate.

An employer is not fully responsible for ex post compensation under this system. Therefore, the wage reduction resulting from the workers' compensation benefits will be more than the employer's liability for benefits. Based on this, the marginal benefit of accident prevention will fall, and fewer resources will be allocated to accident prevention with the anticipation that injury rates will increase. In reality, most firms are not perfectly experience-rated, and this will lead to higher injury rates: "injury rate should therefore be

positively related to compensation benefits as workers respond to higher benefits by taking greater risks on the job" (Thomason & Burton, 1993, p. s8).

Different arrangement of workers' compensation leads to contradicting results:

> …from the employer side of the labor market, then, the effect of the workers' compensating system or higher workers' compensation benefits on resources employers devote to reducing work injuries, and hence injury rate, is ambiguous. If wage differentials do fully compensate workers for the risk of injury and the system is imperfectly experience rated, the injury rate may actually increase. If wage differentials are not fully compensated and the system is perfectly experience rated, the injury rate will decrease. (Ehrenberg, 1988, p. 76)

As Kaufman (1997) and Dorman (1996) have noted, this theoretical analysis has been criticized on numerous different grounds, ranging from the theoretical to the empirical. In any event, it is clear that the particular workers' compensation arrangement and how premiums are calculated are very important in determining the relation between rate of injuries and different characteristics of the industry and some other demographic variables. The only way to investigate the variables and phenomenon under study and to eliminate any apparent contradiction is to conduct empirical analysis.

The aforementioned theoretical relations have been the object of much empirical analysis, and this relation has been under extensive scrutiny since 1972. In that year, the Bureau of Labor Statistics (BLS) started collecting data from each state, and for each industry, on the frequency and severity of reported injuries. From the theoretical discussion above, it can be ascertained that the incident rate depends on the actions of both workers and employers. Injury rates, therefore, are impacted not only by the level of benefits, but how the experience rating has been used in calculating premiums. Empirical studies have approached this issue from a variety of angles.

Using injury data for 2,627 manufacturing establishments in 13 states for 1967 (cross section), Chelius (1974, 1977), who in a 1977 study analyzed homogeneous

industries in 18 states. Using a two-stages least squares technique, Chelius found a positive association between injury rates (measured by frequency rates, severity rate, and serious injury frequency rate) and workers' compensation benefits (evaluated for the laws in effect in 1967 at several wage-levels). He concluded that, "Increases in the proportion of employee accident costs covered by the firm had the effect of increasing injury rates" (Chelius, 1974, p. 714). This indicated that, "higher workers' compensation benefits are not associated with lower injury rates. On the contrary, higher benefit-levels were associated with higher injury rates" (Chelius, 1977, p. 46).

Using state-level claims and injury data for manufacturing industries in 36 states from 1972 to 1975, Chelius (1982) reached different conclusions:

> higher compensation benefits are associated with lower severity rate of injury, suggesting that higher benefit induce employers to spend more on prevention of serious injuries. On the other hand, higher benefits are also associated with higher frequency rates of injuries, suggesting that higher benefits induce employees to take less care in preventing less serious injuries. (p. 235)

In a later study of 28 states, Chelius drew similar conclusions. From 1972 to 1978, he found that a positive association between higher benefits and frequency rates of injuries persists. Unlike his earlier study, he found that benefits impact the severity of injuries.

Butler (1983) studied 15 different industries in South Carolina over 32-year period. Using the two stages least square method, the same pattern of positive association was found between the workers' compensation benefits and different measures of injury rates. Butler and Worrall (1983) results are also consistent with the neoclassical theory that positive association between benefit levels and injury rates (temporary total and permanent partial disability). The sample the authors analyzed consisted of 35 states from 1972 to 1978, and they found that "injury claims increase as wages fall and as benefits increase" (Butler & Worrall, 1983, p. 586).

Ruser's (1985) results also supported the positive correlation between injury rates and benefits. His analysis of outcomes for 25 manufacturing industries in 41 states from 1972 to 1979 is consistent with the hypothesis of a positive relation. Worrall and Appel (1985) concluded that injury severity increases when compensation benefits increase. Krueger's (1989) analysis found a positive relationship between benefits and claims. The longer the waiting period before collecting benefits, the less likely a given claim was to be reported: "a 10% increase in temporary total benefits will lead to a 4.6%-6.7% increase in recipiency" (p. 21). Furthermore, "if the waiting period increased from three to seven days, the workers' compensation recipiency rate would fall by 38.7%" (Krueger, 1989, p. 23). Butler and Worrall (1985) obtained results about the effect of benefits on duration where "a 10% increase in benefits could increase the average claim duration by 0.23 weeks" (p. 722).

Kniesner and Leeth (1989) examined the link between labor market outcome and workers' compensation insurance using a numerical simulation of early 1970s data. They considered whether workers' compensation benefits influenced the reporting of injuries and illnesses. They concluded that "our numerical simulation demonstrates that increases in the WC benefits generally raise reported workplace injuries, but reduce the actual number of workplace injuries" (Kniesner & Leeth, 1989, p. 292).

Most of the above studies selected the timeframe for analysis beginning from 1972 onwards because of an important report published that year (National Commission on State Workmen's Compensation Laws, 1972) that recommended more liberal policies in terms of workers' benefits.

On the other hand, Ruser (1991) demonstrated the positive correlation between injuries and workers' compensation benefits and its consistency with the theory. He stressed the importance and impact of experience ratings where: "larger, more experience-rated firms internalize a greater portion of the costs of the benefits paid to their own injured workers. Hence, they have a greater incentive to increase safety when benefits increase" (Ruser, 1991, p. 347). His results are based on ordinary and weighted least square calculations, where he used a longitudinal micro data set of 2,788 manufacturing establishments, including benefits and employee size measures for the period from 1979 to 1984. The same results are obtained in an indication that large firms are more highly experience-rated than small ones. As Butler and Worrall (1983), Ruser (1985), and Hirsch, Macpherson, and Dumond (1997) all found, large firms with higher experience ratings provide greater incentives to reduce claims.

Many other studies investigated the effect of different job and demographic characteristics on injury rates. For example, Boden and Ruser (2003) analyzed the effect of changes (reform) in workers' compensation (medical provider) and reported injury rates by using BLS workplace injury microdata from 1987 to 1997. They found that limiting a worker's choice of medical providers made it more difficult to file claims, leading to a decline in claim rates.

Hirsch et al. (1997) examined the relation between unions and compensation claims. They turned to individual panel data based on the March Current Population Survey from 1977 to 1992. Their primary finding was that unionization has a substantial effect on indemnity claims—meaning that union workers are more likely than nonunion workers to receive benefits from workers' compensation. Furthermore, a worker's

personal characteristics clearly influence his benefits. For example, a Hispanic worker exhibits a probability of recipiency that is 13.1% lower than the rate for non-Hispanics. The same study also found that compensation claim rates for women are less than those for men.

How unions impact the rate of injuries is a fraught topic. Advocates and opponents of unions often personalize the issue. Partisans issue strident claims that conflict with the equally shrill assertions of the opposing side. Despite the cacophony, there is no decisive or unambiguous answer to the question of whether the presence of unions increases or decreases injury rates. Nor is the correlation between unions and workplace safety unequivocal. Stated differently, it is not clear if the presence of unions increases the likelihood of workers filing injury claims, or whether unions encourage them to do so. Taylor (1987) reexamined the relation between unions and workplace safety based on data for 26 industries between 1975 and 1983. This study, the first of its kind, showed the relation between the degree of unionization and its effect on the rate of incidents. Taylor declared that the relation between workplace safety and unionization is more complex than generally believed. The clearest outcome of the study was that "the average number of lost workdays associated with these more serious injuries increases in direct proportion to the degree of unionization" (Taylor, 1987, p. 450). Taylor's results would seem to provide clear indication that industries which are highly unionized are more likely to report workplace related injuries and illnesses when compared to non-unionized or less-unionized industries.

In a British-based study, Fenn and Ashby (2004) examined the relation or the influence of unions on workplace risks. They found that the presence of unions in the

workplace will increase the probability of reporting these injuries and illnesses, where "establishments with a higher proportion of unionized employees, and with health and safety committees, were associated with higher number of reported injuries and illnesses" (Fenn & Ashby, 2004, p. 461). The most important conclusion from the aforementioned empirical research is that the correlation between the presence of unions and workplace nonfatal injuries and illnesses is positive in most cases.

All these studies seek to explain why it is that injury rates correlate highly with workers' compensation benefits. Among the explanations these studies offer, workers may respond to higher benefits by agreeing to work in riskier jobs, and the higher the risk the higher the probability of injury (workers are willing to take an ex ante risk that results in ex post injury-risk bearing moral hazard). Another possibility is that higher benefits may increase employee incentive to report more claims than might otherwise have pertained to an under-reported claim-reporting moral hazard (Butler, 1991).

Virtually all of the above mentioned empirical work finds that the accident rate, where different proxies such as claim severity and claim frequency have been used, increases as workers' compensation benefits increase. Simply put, they show the positive relation between workers' compensation and injury rates. The evidence came from both individual and aggregate data. Butler (1994) used two different data sets to analyze the relation between benefits and injuries. He found a significant correlation between both severity and frequency of claims and benefits increase. He linked these to decreases in the waiting time for the disbursement of benefits. He offered a concise explanation for the upward trend in workers' compensation claims by asserting that they are a result of two forces: "changes in the program itself—particularly in benefit levels and the waiting

period—and changes in workforce demography—amount of risky employment and among the oldest and youngest" (Butler, 1994, p. 399).

These studies do not suggest that workplace safety is worsening. On the contrary, part of the problem has to do with the inevitable fact that an insurance program will introduce the issue of moral hazard. In the context of this analysis such are termed "report- claiming moral hazards," where workers are more likely to report injury claims when benefits are more liberal. One the other hand, and depending on the degree of experience-rating, higher benefits will increase the incentive on the part of firms to reduce "risk-bearing moral hazards" to minimize insurance costs, and thus injury rates will decrease resulting in greater workplace safety.

The above analysis of the relation between injury rates and workers' compensation benefits, among others, is only one of the explanations of why injury rates have declined. While significant, it is not the only explanation.

CHAPTER III

UNDER-REPORTING

The Occupational Safety and Health Act of 1970 requires almost all private sector employers to keep record of workplace related injuries, illnesses and fatalities, and the Department of Labor to collect and compile accurate data on occupational injuries illnesses and fatalities. However, officials of both the Department of Labor and the Occupational Safety and Health Administration (OSHA) consistently claim that injuries, illnesses and fatalities related to the workplace are declining—a contention which naturally would serve to demonstrate the efficacy of their programs in preventing workplace injuries illnesses and fatalities. In contrast to these claims, many academic researches as well as media reports have shown that work related injuries and illnesses are chronically underreported.

Both employers and employees to some extent can control the risk of an accident occurring through such measures as providing safer work environments through introducing safer technology, providing protective equipment and training, even though some incidents will still inevitably occur, and a 100% injury-proof workplace is next to impossible. In the eventuality of an accident it is a costly occurrence for both employer and employee, where the cost to the employee will either be tangible as with a

loss of income resulting from lost work days and wages, to say nothing of medical and rehabilitation expenses, especially in case of injuries that develop subsequently, or intangible injuries such as pain and suffering resulting from injury and anxiety over potential future injury. Injury for the employer represents costs in interruption and delay of the production process, damage of equipments and materials, and searches for replacements, where some studies estimated the total cost of fatal- and nonfatal injuries in construction at $11.5 billion in 2002 (Waehrer, Dong, Miller, Men, & Haile, 2007). At the same time the cost of nonfatal injuries in construction among Hispanics in 2002, using Medical Expenditure Panel Survey, was $291 million (Dong et al., 2010). For these reasons, given the costly consequences of an accident and also that any job presents some level of risk of employee injury, usually the behavior of both the employer and employee, also the economic incentives for both are of great significance in determining whether or not to report any incident. The dynamics of the relation between employer, employee as well as the presence of economic- and demographic factors exert a major impact on injury determination.

Our research focuses on discussing how the presence of Hispanics in construction will contribute to the presence underreporting of injuries. Workers' Compensation (WC) and Bureau of Labor Statistics (BLS) annual Survey of Occupational Injuries and Illnesses (SOII) are the most two important monitoring agencies in the Unites States, but despite the comprehensiveness of their efforts, there is evidence of underreporting of work injuries, and although this problem was recognized a long time ago, quantifying it has been relatively recent.

Conway and Svenson (1998) explain the decline in injury and illness rates in the 1990s as a result of: 1) employment shifts away from hazardous industries; 2) underreporting of injuries and illnesses; 3) workers' compensation reform; 4) industry recognition of hazards; and 5) OSHA measures to increase compliance. It is clear that underreporting was one of the causes for the trend in decline in injuries and illnesses over time among others, and the disincentives to report work-related injuries and illnesses has to do with the OSHA recordkeeping program on one side, and company characteristics (employer incentives) and worker characteristics (employee incentives) from the other side.

According to the BLS (2010d), there were 3.7 million private industry injury- and illness cases reported in 2008 as compared to 4 million cases for 2007. Even though these numbers are high, they still suffer from underreporting that according to some researchers led to the decline in the injuries rate over time. In 1987 the BLS conducted a pilot study to test and compare different recordkeeping systems including medical records, workers' compensation reports, OSHA logs, and other types of workplace records. The study encompassed 200 manufacturing establishments that employed more than 10 workers in Massachusetts and Missouri, and for these approximately 4000 cases of injury and illness were recorded. The study uncovers evidence of underreporting as well as over-reporting, with the underreporting cases being split between cases with- and without lost work time. About 10% of total injuries and illnesses were underreported and about 25% of injuries with lost workdays suffered from underreporting in these establishments (Eisenberg & McDonald, 1988). This study is an early indicator of quantitative evidence for how chronic and persistence the underreporting problem is.

Some scholars have tried to explain why the national monitoring system suffers from this problem while others have attempted to quantify it. Here, initially, the academic research that quantified underreporting will be examined before assessing the other primary trend in the literature which discusses the reasons underlying underreporting.

Boden and Ozonoff (2008) examined two major sources that report injuries and illnesses (BLS-SOII- and workers' compensation). They studied six states (Minnesota, Wisconsin, New Mexico, Oregon, Washington, and West Virginia) from 1998 to 2002 by using a capture-recapture method–a technique used in epidemiology. They found that the workers' compensation system missed over 180,000 lost-time injuries for the six states, while the BLS system missed about 340,000 cases and about 69,000 injuries were underreported in the case of either system. These results showed that the Survey of Occupational Injuries and Illnesses (SOII) which is under the BLS suffers more than does the workers' compensation system from the underreporting problem. In a different study Friedman and Forst (2007) used Trauma Registry data for Illinois from 1995 to 2003 to estimate the number of workers who suffered work-related injuries in the state and compared to the numbers reported by the BLS. The advantage of this system--Trauma Registry of Illinois-- is that it does not depend on self- (employer) reporting as does the BLS, so the numbers reported have a higher probability of being accurate. They found the rate of workplace injuries in Illinois was steady over this period in contrast to the BLS reports that suggested the rate for the same period for the state declined by about 37.4%. In other words, the Trauma Registry figures suggest an anomaly in the realm of reporting and not an actual decrease in injury rate.

A different study by Rosenman et al. (2006) for the state of Michigan examined five different systems for injury and illness data including BLS (workers' compensation; the OSHA annual survey; the OSHA integrated Management Information System; the Occupational Disease Report; and the SOII of the BLS) from 1999 to 2001. They concluded that SOII missed up to 68% of the work-related injuries and illnesses that occurred annually in Michigan, and they also estimated that BLS records captured only 33% of injuries and about 31% of illnesses. From this sort of data it is clear that underreporting is a major problem pervading the entire national monitoring system as whole—a system that collects sensitive data upon which major research and public policies depends. Morse, Dillon, Warren, Hall, and Hovey (2001) and Morse et al. (2005) implemented capture-recapture methodology to investigate the underreporting problem related to musculoskeletal disorders (MSD) in Connecticut utilizing data from workers' compensation reports and physicians' reports. The first study estimated that in 1995 underreported cases exceeded official reports by a ratio of 11:1, while the second study contradicts the BLS findings that assert a decline in MDS in Connecticut and the actual number was six times higher than what the BLS reported. Using National Health Interview Survey (NHIS) for the United States from 1997 to 1999, Smith et al. (2005) found that injuries that resulted in days away from work for private industries were 1.4 times higher than what the BLS reported, and if government workers and self-employed are included the injuries were 1.8 times higher. Differently stated, the study showed that work-related injuries and illnesses are 40% and 80% higher, respectively, than what the BLS reports for private industry and when government employees are included. What is known about the BLS survey data is that they exclude certain work-related injuries and

illnesses for a group of employees (usually federal government employees, state and local government employees, railroad workers, nonagriculture self-employed), and given that the problem of underreporting according to the previous studies is already huge, the vast scope can only be imagined for underreporting cases when they are included. Leigh et al. (2004) examined underreporting in the case where all of the excluded employees are included and concluded that BLS-SOII missed between 33% and 69% of all work-related injuries and illnesses. Using Canadian survey data Shannon and Lowe (2002) estimated that 40% of eligible injured workers did not file for workers' compensation claims.

The construction of Denver International Airport (DIA) provided a unique opportunity to study all aspects of workplace injuries and illnesses as they happened in real-time. It provided a wealth of data and constituted an actual experiment that furnished an empirical measure with which to assess BLS reports in regard to occupational injuries and illnesses. Glazner et al. (1998) studied this project and compared data from two different sources (payroll, workers' compensation) to the data published by the BLS. Their estimates of total work-related injuries and illnesses based on data from payroll and workers compensation was more than twice the rate of what BLS reports showed during the project years.

From the foregoing literature review it is apparent that underreporting is a major problem from which most of the current monitoring system suffers, while meanwhile, the severity of the problem as measured by the magnitude of underreporting is not declining over time. From the earliest study to the most recent one, the overall magnitude has remained almost the same and in some cases it is even increasing over time in certain industries and for a certain type of employees. Efforts to mitigate the problem must start

from an understanding of the driving forces behind it, where the causes for underreporting must be determined in the first place and the question of why occupational injuries and illnesses should be underreported be answered.

There are number of reasons behind injuries and illnesses being underreported to the national monitoring system like BLS, workers compensation, and SOII among others. Underreporting can be due to industrial factors (employee incentives) and also to individual factors (workers' incentives). The interchangeable relation between employees and workers is a major cause of the underreporting problem from which current monitoring systems suffering. Fan, Bonauto, Foley, and Silverstein (2006) examined underreporting to workers' compensation in 2002 for Washington state and found a strong correlation between certain individual- and industrial factors and underreporting. Their findings were not appreciably different from other studies with 52% of workers who suffered work-related injuries reported to workers' compensation which is a little higher than findings of some other studies.

Examining the events or sequence of events that might lead to work-related injuries and illnesses being underreported is crucial to understanding the problem and also provides insights into how to remedy this problem or to mitigate it to some extent given that 100% reporting of injuries and illnesses would be almost next to impossible with existing reporting and oversight mechanisms.

Azaroff et al. (2002) criticized major national monitoring agencies including the BLS for the quality of the data describing them as "fragmentary, unreliable, inconsistent, and underestimate[ing] the incidence of injuries and illnesses" (p. 1421). With the help of a filtering system, which they adapted from Webb, Redman, Wilkinson, and Sanson-

Fisher (1989), they showed that the process of documenting work related injuries and illnesses involves a complex series of events during which many of these injuries and illnesses and many cases will be lost in the documentation process. The study shows that the process of documenting any work-related injuries and illnesses confronts partial barriers and obstacles before being reported to any of the national monitoring systems. Their argument is that within the documentation process there inhere some obstacles that will filter out and block the reporting of many cases, especially those for low wage workers and immigrants where they considered a significant portion of the labor force. A follow up work by the same authors (Azaroff et al., 2004) used the filtering system as an alternative interpretation to explain why work-related injuries and illnesses are declining, and claiming that the decline in injuries and illnesses was due to underreporting and not attributable to other factors that some researchers claim are behind the decline. The filtering model they adapted will explain the barriers facing documenting injuries and illnesses in BLS, workers' compensation and medical data bases.

The filter model proposed by Azaroff shows the sequence of events for documenting work related injuries and illnesses to different systems. At the same time it shows the conceptual filters that partially block the reporting process. The authors also estimated how much many related injuries and illnesses are lost during the reporting process based on the previous literature. In the study, each filter blocked or impeded the reporting at different degrees. When a work related injury happens either the worker will report to the supervisor or will be submitted to medical care. According to this filtering model, between 24 and 94% of cases will be lost before even reported to the supervisor. If the injury is successfully reported to the supervisor it needs to be classified if the injury

is severe and requires days away from work. Around 90% of injuries will be lost and not classified to require days away from work. This filtering model as mentioned developed to explain the obstacles to reporting injuries and illnesses.

The reasons behind not being able to report injuries and illnesses by both employees and workers given in the previous studies included the perception of injuries as simply being 'part of the job'; workers' fear of being reprimanded or disciplined; being labeled as a 'complainer'; being considered 'careless'; consider an injury to be 'minor'; the difficulty in recognizing the relatedness of an injury to work; company goals for not reporting as part of the incentives program of a company; harassment; loss of promotional opportunities; transfer to less desirable jobs or locations; deportation; job loss; and denial of overtime. While for his part, a manager's incentives for not reporting can include poor evaluations; the loss of raises and bonuses (Azaroff et al., 2004, 2002).

However, according to Azaroff et al. (2004) the political, economical and legal reasons behind the difficulty of reporting started back in the 1980s and 1990s. These reasons are:

- Growth in economic activity.
- Exclusion of increasing numbers of immigrant workers from reporting systems.
- Spread of incentive systems that reward low levels of reported injuries and illnesses.
- Declining access to medical care.
- Increasing obstacles to establishing work-relatedness of injuries.
- Workers' compensation reform. (Azaroff et al., 2004, p. 275)

In this work, the focus will be on the factor of Hispanic immigrant workers and how their presence in the labor force will increase the chances of injuries and illnesses being unreported.

The Hispanic Work Force

The United States population is growing and so its racial and ethnic composition is changing, with Hispanics as the nation's largest ethnic minority group and the fastest growing one at the same time, with 46.9 million in 2008 compared to 35.3 million in 2000 census accounting for about 15.4% of the total United States population and an astonishing growth of about 32% in less than a decade (Pew Hispanic Center, 2010). The Hispanic population has almost tripled in the past 30 years and so their participation in the labor increased, especially in jobs with low skills and most likely dangerous like agriculture and construction among others.

There is not much literature or empirical research or, even for that matter, even sufficient data on Hispanics' in general. This problem becomes even more acute when trying to obtain data about Hispanics' injuries and illnesses and other more specific data about undocumented Hispanic workers, and if such research is found it will likely be both very recent and of a small sample size. This is why we do not see a plethora of research related to Hispanics or other minority groups.

According to the BLS figures, the Hispanic labor force is mostly concentrated in agriculture followed by construction. In terms of their relative percentages when compared to other minority groups, in 2009 Hispanic employment in construction reached about 2.3 million or about 23.5% of total construction employment the second after agriculture with 28.5% of total employment (BLS, 2010c). During the same year,

construction absorbed about 9.7 million workers out of a total labor force in the nation which represents about 7%; but this industry suffered a disproportionate number of death cases of 816 case out of 4340 cases, representing about 18.8%; also the Hispanic share was about 15% with 668 cases of death out of the total number of death cases in private industry in the nation (BLS, 2010b). Data for construction deaths among Hispanic workers in 2009 are not currently available, but Hispanic death cases in construction in 2008 represent 4.7% out of total number of fatal injuries in the nation, and 24.6% in construction alone. A more detailed picture of how fatal occupational injuries are distributed across different ethnic groups can be ascertained from the following information.

Since 1992 when the Census of Fatal Occupational Injuries was established, the total number of fatal injuries is 105,497 cases, of which the total number of Hispanic fatalities is 13,712 which represents approximately 13% of the total. Another point is that the number of fatal work injuries involving Hispanics has risen each year since 1992 from 533 cases to 990 fatal cases in 2006.

One important observation from Table 1 is that foreign-born Hispanic workers' fatal occupation injuries are higher than US-born Hispanic workers for all years since 1992, even though the total number of fatal work injuries for the same period declined by 1877 cases or about 30.2%; the same is true for fatal injuries in construction where the same period witnessed a decline in the number of fatal injuries. Figure 7 shows that total number of fatal injury cases for the whole economy or for construction is declining, but Hispanic fatal injuries in construction increased from 104 cases in 1992 to 250 cases in 2008, while fatal injury cases are declining for all other races.

Table 1. Number of Fatal Occupational Injuries Involving Construction Hispanic Workers 1992-2009

Year	Total number of fatal work injuries	Total number of fatal work injuries in construction	Total number of Hispanics fatal work injuries	Foreign born Hispanic workers	Foreign born Hispanic workers as %	Native born Hispanic workers	Total number of Hispanics fatal work injuries in construction
1992	6217	919	533	275	51.59	258	104
1993	6331	932	634	320	50.47	314	103
1994	6632	1028	624	336	53.85	288	110
1995	6275	1055	619	342	55.28	277	142
1996	6202	1047	638	371	58.15	267	133
1997	6238	1107	658	379	57.60	279	166
1998	6055	1174	707	405	57.28	302	211
1999	6054	1191	730	468	64.11	262	224
2000	5920	1155	815	494	60.61	321	277
2001	5915	1226	895	572	63.91	323	280
2002	5534	1125	841	578	68.73	263	244
2003	5575	1171	794	520	65.49	274	264
2004	5764	1278	902	596	66.08	306	317
2005	5734	1243	923	638	69.12	285	321
2006	5840	1297	990	667	67.37	323	360
2007	5657	1239	937	534	56.99	303	317
2008	5214	1016	804	503	62.56	301	250
2009	4340	816	668	393	58.83	275	
Total	105497	20019	13719	8391	61.16	5221	3823

Source: (BLS, 2010b).

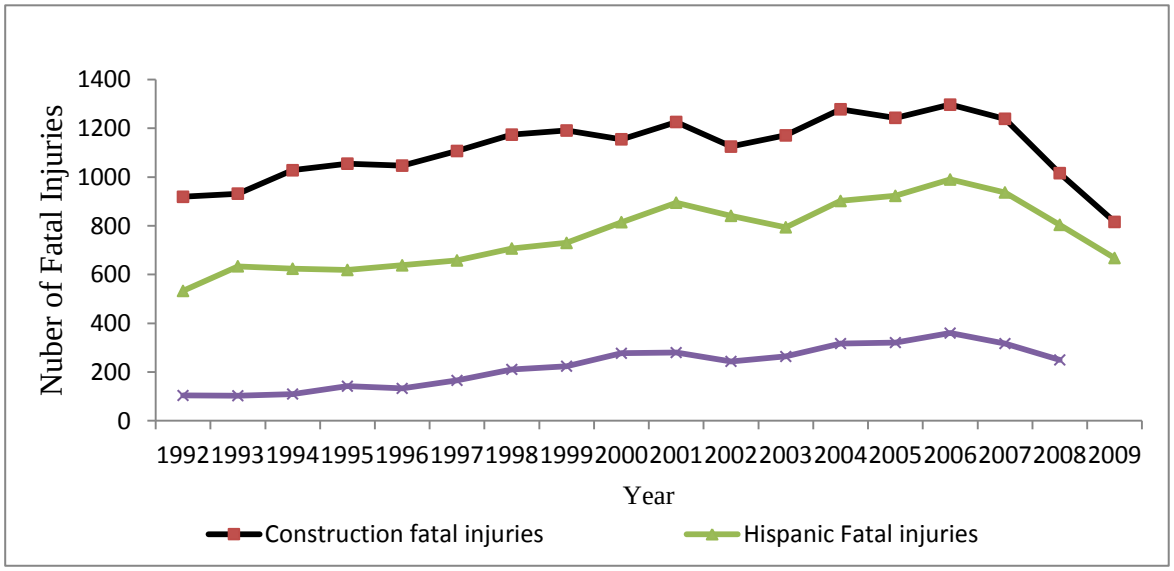

Figure 7. Fatal construction injuries for Hispanics.

As can be seen, Figure 8 the share of fatal occupational injuries in construction for foreign-born Hispanics has increased whereas it has remained steady among US-born. For example, foreign-born Hispanics' fatal injuries as a percent of total Hispanic fatal injuries was about 59%, with the lowest in 1993 and the highest in 2005. This increase in fatal injuries for foreign-born workers over time happened at a time when the overall fatal occupational injuries cases were declining.

Although fatalities decreased during 2008 and 2009 because of the recession, fatalities in construction still represented about 20 and 19% of total reported nations work-related deaths, respectively. This number is relatively high given the fact that construction absorbed only about 8% of the work force during these years. The number of fatalities in construction reflects the fact that employment in construction fluctuates in relation to the nation's economy, meaning more workers during economic boom and less during recessions. We can see this trend in fatal injuries in construction and how it fluctuates during the business cycle. For example, between 2007 and 2008 number of fatal injuries in construction declined by 18% while it increased by about 41% between 1992 and 2006.

The trend for occupational injuries and illnesses with days away from work in construction for Hispanics compared with white non-Hispanics is another important indicator to consider when investigating underreporting. We see that number of occupational injuries and illnesses with days away from work is declining for all industries and for construction as well. Comparing Hispanics with White non-Hispanics reporting of injuries and illnesses with day away from work in construction we see that it is increasing for Hispanics and decreasing for White non-Hispanics.

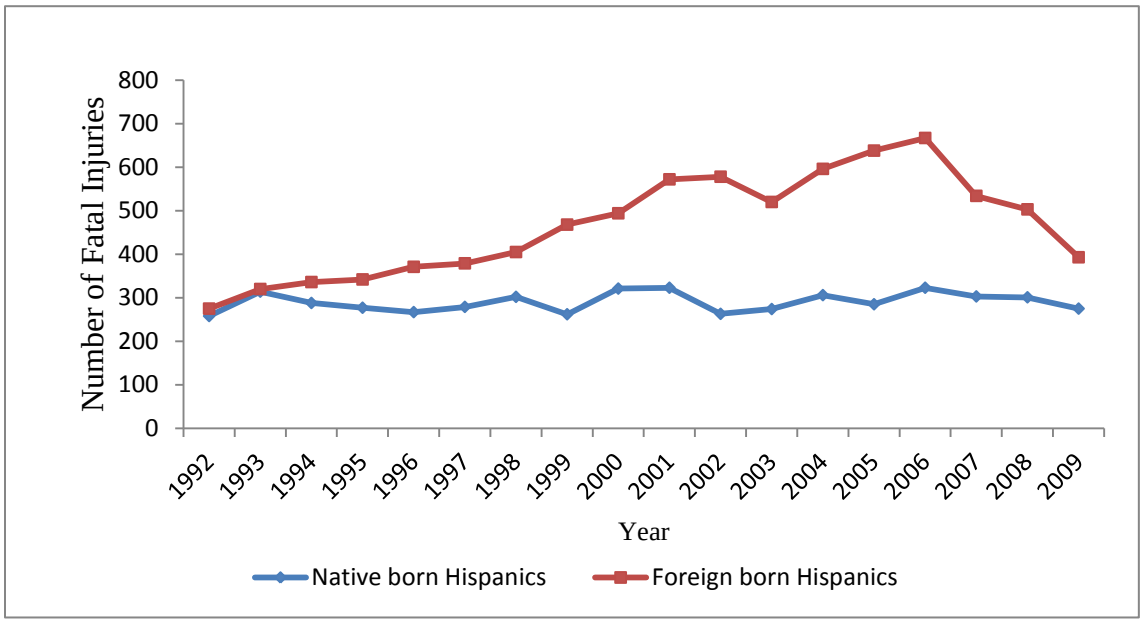

Figure 8. US-born vs. foreign born Hispanic fatal injuries.

From Table 2 and Figure 9 we see that Hispanics' injuries with days away from work increased between 1992 and 2008 from 17715 cases to 25360 cases or by about 30%, while at the same time their representation increased. On the other side the statistics for Whites were completely the opposite.

These facts about foreign-born workers and immigrants in general suggest that they are more likely to take more dangerous and risky jobs than US-born, and therefore, it is to be expected that this will account for a higher proportion or higher representation of Hispanics in agriculture and construction. Even if the percentage of non-Hispanics at one point or another is higher in these sectors of the economy, nevertheless, it is found that immigrants and foreign-born workers will be occupying and performing the more dangerous tasks (Orrenius & Zavodny, 2009).

Table 2. Number of Nonfatal Occupational Injuries and Illnesses Involving Days Away from Work by Selected Worker and Case Characteristics and Industry, All US Private Industry

Year	Total	Construction	Hispanic	White non Hispanic	Percentage distribution of Hispanics	Percentage distribution of White non Hispanics
1992	2331098	209564	17715	143555	8.45	68.50
1993	2252591	204769	18017	141577	8.80	69.14
1994	2236639	218835	17739	150093	8.11	68.59
1995	2040929	190591	18995	125335	9.97	65.76
1996	1880525	182334	19713	120727	10.81	66.21
1997	1833380	189839	22501	123793	11.85	65.21
1998	1730534	178341	22990	112896	12.89	63.30
1999	1702470	193765	28757	121504	14.84	62.71
2000	1664018	194410	26583	119081	13.67	61.25
2001	1537567	185662	29749	110592	16.02	59.57
2002	1436194	163641	26133	98674	15.97	60.30
2003	1315920	155420	26750	88530	17.21	56.96
2004	1259320	153200	27990	90020	18.27	58.76
2005	1234680	157070	32770	90070	20.86	57.34
2006	1183500	153180	33930	83100	22.15	54.25
2007	1158870	135350	25480	75750	18.83	55.97
2008	1078140	120240	25360	66810	21.09	55.56

Source: (BLS, 2010b).

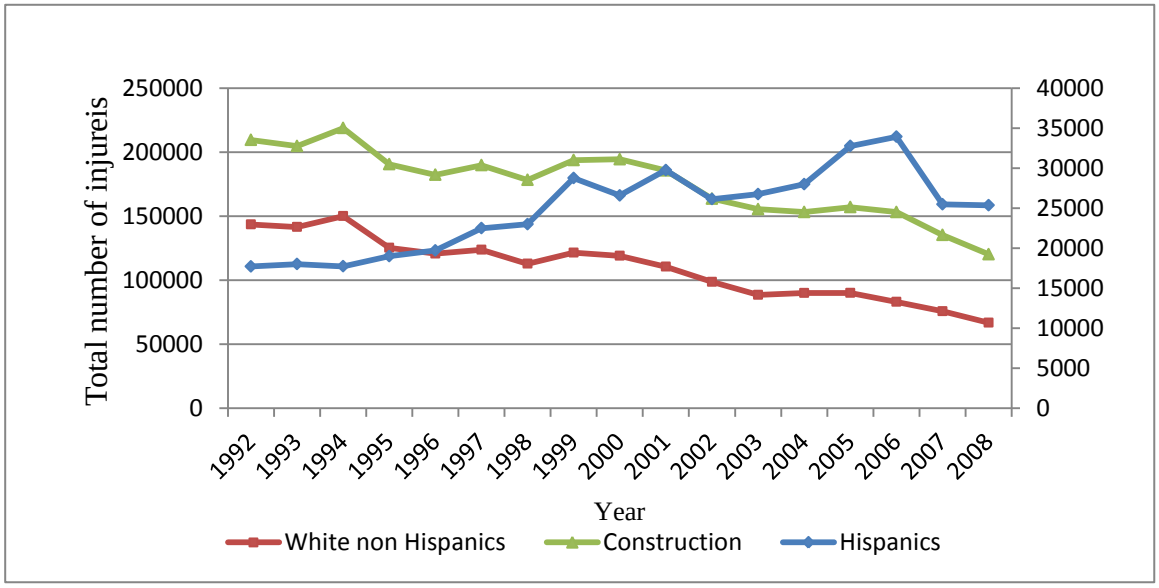

Figure 9. Days away from work in construction by race.

Another salient point that appears in Table 1 and 3 is that even though numbers of fatal occupational injuries for most other groups of workers are declining, fatal occupational injuries for Hispanic workers appear to be increasing. There are many reasons behind this obvious trend of fatal occupational injuries among foreign-born Hispanic workers. Typically, foreign-born workers are disproportionally represented in occupations with higher risk of injuries as well as in lower-paying jobs, and these trends are due to the limited opportunities and job options for those workers due to factors—by no means exclusive—such as: lower educational levels; poor language skills; as well as the legal and economic structure of the hiring system (Loh & Richardson, 2004).

The dearth of research targeting Hispanics in general and their representation in the most dangerous job with focus on fatal and nonfatal occupational injuries gives an impression of ignorance for a very important and dynamic sector of the population. The need for more research on Hispanics is urgent given some of the facts elucidated above. As Brunette (2004) notes:

> To date, very little construction safety and health research has been conducted involving Hispanic workers. While there might be some ongoing research projects targeted to construction Hispanics worker's safety, their dissemination process maybe quite poor. Lack of publication in peer reviewed journals and in other relevant sources of information gives the impression that minimal or no research activities targeted to the Hispanic construction workforce in the United States are being taken by the research community. (p. 244)

The research of Dong and Platner (2004) and Dong et al. (2010) targeting Hispanics' fatal occupational injuries in construction is among the few studies focusing on Hispanic construction worker fatalities, with emphasis on demographics and cultural characteristics to explain the trend in workplace deaths. Both studies stressed the fact that Hispanic construction workers face higher risks of fatal and nonfatal injuries. Even though the numbers are high relative to other ethnic groups, actual Hispanic

Table 3. Number of Fatal Occupational Injuries by Race: 1992-2008

Year	Total number of fatal work injuries	White	Black or African American	Asian or Pacific Islanders	American Indian or Alaskan Native	Other Races not Reported
1992	6217	4711	618	169	36	150
1993	6331	4665	649	190	46	147
1994	6632	4954	695	179	39	141
1995	6275	4599	684	161	27	185
1996	6202	4586	615	170	35	158
1997	6238	4576	661	195	34	114
1998	6055	4478	583	148	28	111
1999	6054	5019	627	192	57	146
2000	5920	4244	575	185	33	68
2001	5915	4175	565	182	48	50
2002	5534	3926	491	140	40	96
2003	5575	3988	543	158	42	50
2004	5764	4066	546	180	28	42
2005	5734	3977	584	163	50	35
2006	5840	4019	565	159	46	61
2007	5657	3867	609	172	29	43
2008	5214	3663	533	152	32	30

Source: (BLS, 2010b).

fatalities might be even higher still given underestimation and undercounts as errors that typically arise in the process of capturing data about the informal sector workers where Hispanics tend to be concentrated. Additionally, rate research in regard to Hispanic construction workers is of the type focusing on nonfatal injuries simply because it is much simpler to avoid reporting nonfatal injuries than fatal ones. As mentioned above, studies have proven that data reported by BLS on nonfatal construction injuries are less than the actual number (Glazner et al., 1998), not to mention that a large portion of the labor force is intentionally excluded from the Survey of Occupational Injury and Illnesses (SOII).

Documenting nonfatal injuries among Hispanic construction workers so as to ascertain whether or not they are suffering a rate higher than that of their counterparts is not an easy task given the nature of the industry itself and overall lack of information

related to Hispanics. For nonfatal injuries among Hispanic construction workers Dong et al. (2010) concluded that:

> Hispanics were nearly 30% more likely to have medical conditions due to work related injuries than white, non-Hispanics, after controlling for occupation, gender, age, and education. Also, when measured in terms of lost workdays, injuries were more likely to be greater in severity for Hispanics compared with whites. (p. 567)

The compiled evidence rules out any possible denial of the fact that Hispanics are prone to higher fatal and nonfatal injuries in construction (in less skilled industries) compared to other ethnic and racial groups (Anderson, Hunting, & Welch, 2000; Forst, Avila, Anozei, & Rubin, 2010; Pransky et al., 2002).

Very rarely has research been conducted to estimate or quantify the influence of the existence of Hispanic workers on underreporting in construction or in any other industry. This work will be the first attempt to examine the Hispanic factor on underreporting of injuries and illnesses in construction.

CHAPTER IV

DATA AND MODEL

To date, very little empirical research has examined the issue of under-reporting of workplace related injuries and illnesses in construction focusing on the Hispanics. The data used ranged from state level data to the level of individuals, and as mentioned before, all the previous studies investigated this issue by focusing on the manufacturing sector and, in many cases, only studying the under-reporting issues in general and without any focus on any specific factor. Herein lies my departure from the previous research, where construction industry and Hispanics will serve as the main units of investigation to examine under-reporting. In this research, the data will be state-level data for the construction industry in general and six different occupations within construction covering electricians, carpenters, masons, roofers, residential construction workers, and plumbers. The structure of the data will be state panel- longitudinal- data over the period from 1976 to 2008. Injury rate (incident rate) data, where the incident rate represents numbers of injuries and illnesses per 100 equivalent full time workers and the data are collected for five types of injuries, which are total cases, total cases with lost work days, cases away from work, cases with no lost work, and finally light duty-job transfers or restrictions. With the exceptions of Colorado, Idaho, Mississippi, New Hampshire, North Dakota, Ohio, Pennsylvania, and South Dakota, the data for each state

as well as the District of Columbia have been collected from publications of the United States Bureau of Labor Statistics (BLS) *Survey of Occupational Injuries and Illnesses,* (1976-1995), and the remainder of the data from http://www.bls.gov/iif/oshstate.htm (1996-2008). The BLS website does not always include data from 1995. In the case of Wyoming, for example, the data from the BLS website was first reported beginning in 2002, and it does not contain the Illinois data for injuries and illnesses prior to 1998. This means that the data for these states and others for which reporting did not begin in 1995 were collected from the previous source (*Survey of Occupational Injuries and Illnesses*). One problem with the data recording of the BLS is that until 2001, incident rate of occupational injuries and illnesses tables were divided into two major incidents: injuries and illnesses. Since 2002, however, the same data have been combined into a single figure. While this difference is worth noting, it will not adversely impact the analysis because illnesses constitute such a small percentage of the overall rate. Illnesses rates had negligible impact, and may therefore be ignored at this point. That is, based on the available data from the BLS about nonfatal occupational injuries and illnesses, illnesses represent only about 2.5% of the overall nonfatal occupational injuries and illnesses in construction. From this point the total cases of injuries and illnesses are divided into categories where the incident in question caused any loss of work days or not, and based on this information we can calculate (if such information is not given) job transfer or job restriction, which is coded as light duty in this research and is considered as indicative of one of the main injury types that sheds some light on the issue of under-reporting with the presence of Hispanics in the work force. The under-reporting problem—when Hispanics are present in the industry—is concealed in this last variable

for the category of reassignment to “light duty.” A reassignment to “light duty” implies that an injury has occurred. The data show that reassignments to light duty are increasing, even while other types of injuries are declining. For example, injuries and illnesses with days away from work are declining, as are total recoded injuries and illnesses.

Table 4 shows all types of nonfatal injuries and illnesses for private construction industry workers for the United States since 1976. It is immediately apparent that total recorded injuries and illnesses are declining over time, from 15.3 cases per 100 full time equivalent workers (FTEW) in 1976, to 4.7 cases per 100 full time equivalent workers (FTEW) in 2008, or a decline of about 70%. On the other hand, injuries that resulted in job transfer or restrictions (light duty) increased for construction from 0.1 cases per 100 full time equivalent workers (FTEW) in 1976, to 0.8 cases per 100 full time equivalent workers (FTEW) in 2008. This is an overall increase of 700%. The same phenomenon can be observed in almost all industries with an increasing trend of incident rate of injuries with restricted work activities (light duty).

Injuries that required job transfer of restrictions (light duty) peaked to 1 case per 100 full time equivalent workers (FTEW) for 6 years from 2001 to 2006, and then declined to 0.8 case per 100 full time equivalent workers (FTEW) in 2008. It seems that these changes are likely due to a better recording and coding mechanism, and workers who are more aware of their rights when it comes to injuries.

Graphically this construction industry behavior in regard to be workplace injuries and illnesses for United States private industry can be visualized in Figure 10.

Table 4. Nonfatal Injuries and Illnesses for Private Construction Industry Workers for the Entire United States Since 1976

Year	Total cases	Lost workdays cases total	Lost workday with days away from work	Cases without lost workdays	Light duty
1976	15.3	5.5	5.4	9.8	0.1
1977	15.5	5.9	5.8	9.6	0.1
1978	16	6.4	6.3	9.6	0.1
1979	16.2	6.8	6.6	9.4	0.2
1980	15.7	6.5	6.3	9.2	0.2
1981	15.1	6.3	6.1	8.8	0.2
1982	14.6	6	5.8	8.6	0.2
1983	14.8	6.3	6.1	8.5	0.2
1984	15.5	6.9	6.6	8.6	0.3
1985	15.2	6.8	6.5	8.4	0.3
1986	15.2	6.9	6.6	8.3	0.3
1987	14.7	6.8	6.4	7.9	0.4
1988	14.6	6.8	6.5	7.8	0.3
1989	14.3	6.8	6.3	7.5	0.5
1990	14.2	6.7	6.2	7.5	0.5
1991	13	6.1	5.6	6.9	0.5
1992	13.1	5.8	5.3	7.3	0.5
1993	12.2	5.5	4.9	6.7	0.6
1994	11.8	5.5	4.9	6.3	0.6
1995	10.6	4.9	4.2	5.8	0.7
1996	9.9	4.5	3.7	5.4	0.8
1997	9.5	4.4	3.6	5	0.8
1998	8.8	4	3.3	4.8	0.7
1999	8.6	4.2	3.3	4.4	0.9
2000	8.3	4.1	3.2	4.2	0.9
2001	7.9	4	3	3.9	1
2002	7.1	3.8	2.8	3.2	1
2003	6.8	3.6	2.6	3.2	1
2004	6.4	3.4	2.4	3	1
2005	6.3	3.4	2.4	2.9	1
2006	5.9	3.2	2.2	2.7	1
2007	5.4	2.8	1.9	2.6	0.9
2008	4.7	2.5	1.7	2.2	0.8

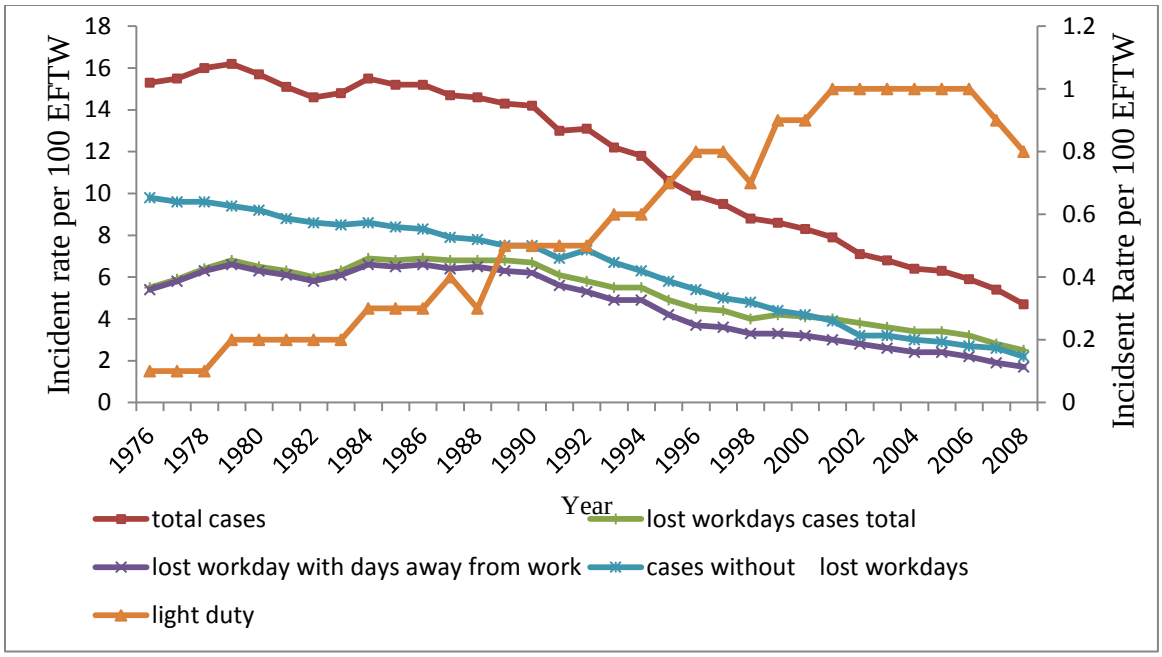

Figure 10. Construction injuries and illnesses trend.

The data reported by the Bureau of Labor Statistics (BLS) are considered incomplete and at some point questionable, because the Bureau of Labor Statistics (BLS) usually collects its data by conducting a survey of Occupational Injuries and Illnesses (SOII) and typically only private industries are included; the self-employed are not required to report any injuries and illnesses.

BLS data may not always be complete because of the many exceptions to its reporting requirements. The BLS survey data excludes the self-employed, farms with fewer than 11 employees, private households, federal government agencies, state and local government agencies. This casts doubt on the quality of the data in general, and particularly for the construction industry. Statistics show that about one-fourth of construction workers are self-employed, and therefore, this leads to a substantial gap in the information about health and safety for those workers. A related problem is the method of data collection. Usually, BLS survey data are based on OSHA logs that employers are required to maintain. Because these logs are often the source of BLS data,

the quality of the data reported often depends on the employer. The employer may be limited in his knowledge of what to report, and the logs are also subject to his judgment of which incidents are work-related and which are not. The honesty of the employer further complicates matters. Because of these factors, the data reported by the BLS are likely skewed by under-reporting. This problem becomes even more pronounced in construction because of the nature of the industry, where small establishments predominate, and the demographics of the employees resist accurate reporting. Another methodological problem with BLS data on injury rates pertains to coding.

A new system of coding industries and occupations has been used since 2003. In 2003, BLS changed its coding system of industries and occupation and officially adopted the North America Industry Classification System (NAICS) coding system. Previous to this, the agency had used the Standard Industrial Classification (SIC) coding system. The main goal of the NAICS is to facilitate accurate comparisons between the United States, Canada, and Mexico. The NACIS system uses a production-oriented coding schema employing six digits, which allows for more flexibility than the two-digit coding system under SIC. The new system groups industries according to the production process used, rather than the system utilized by SIC. Table 5 gives a sample of this coding system. The transition from the SIC coding system of 1987 to the NAICS coding system of 2002 for construction is outlined in Table 6. The major problem that faces the researcher with this transition to the new system is the comparability of the data between the two periods and the two different coding systems.

Table 5. NACIS Coding System

Code	Digit	Sector	Example
23	First two	Major Sector	Construction
236	Third	Subsector	Construction of Buildings
2361	Fourth	Industry Group	Residential Building Construction
23611	Fifth	NACIS International Industry	Residential Building Construction
236117	Sixth	National Industry (US)	New Housing Operative Builders
236118	Sixth	National Industry (US)	Residential Remodelers

Source: (The Center for Construction Research and Training, 2007).

Table 6. 1987 SIC Coding vs. 2002 NAICS Coding

1987 US SIC Description	1987 SIC	2002 NAICS US Description	2002 NAICS
		Construction	23
General Building Contractors	15	Construction of buildings	236
Residential Building Construction	152	Residential building construction	2361
Plumbing, Heating, Air-conditioning	1711	Plumbing, heating, and air-conditioning	23822
Painting and paper hanging	1721	Painting and wall covering contractors	23832
Electrical work	1731	Electrical contractors	23821
Masonry, stonework, and plastering	1741	Masonry contractors	23814
Carpentry and floor work	1751	Finished carpentry contractors	23835
Roofing, siding, and sheet metal work	1761	Roofing contractors	23816

Source: (The Center for Construction Research and Training, 2007).

The workers' compensation rate was collected and hand-coded from the Engineering News Record (2008) "*Third Quarterly Cost Report*," where data are available for the period of study. The values for workers' compensations are per $100 payroll by state, occupation, and year. I matched their classification of work with 1987 SIC and 2002 NAICS because each category is not specified or correlated with any of the national coding systems mentioned above. Because there is no classification for residential building construction that corresponds to that of the two systems—SIC 152 and NAICS 2361, respectively, I used carpentry—1, 2 family residence as a proxy for the

above mentioned codes, and I also used general carpentry as a proxy for carpentry that would theoretically correspond to SIC 175 and NAICS 23835, respectively.

Another caveat when examining the workers' compensation data is that data for some states are missing. There are three different ways an industry or an employer can obtain worker compensation insurance: first, through a private carrier; second, by being self-insured; and finally, through the state. Over time there have been changes in state regulations regarding who is eligible to provide workers' compensation insurance. As of 2008, 47 jurisdictions out of 51 allow private carriers to write insurance policies; 26 jurisdictions had monopolistic state funds that pay workers' compensation benefits; and, finally, all jurisdictions except Wyoming and North Dakota allow employers to be self-insured (Sengupta, Reno, & Burton, 2010). Given the fact that different states have different insurance arrangements, this data set is missing information about workers' compensation rates for states with monopolistic state funds from 1983 to 2008, and these are: North Dakota, Ohio, Washington state, Wyoming (where data are also missing for the years from 1978 to 1981), West Virginia, and Nevada (which changed from state-funded insurance to competitive private insurance in mid-1999). Workers' compensation rates per $100 payroll are nominal values given for each year; to facilitate comparisons between years, those values were adjusted for inflation and the real values calculated for 2008 prices.

Data about average weekly wage (also adjusted for inflation), number of establishments and annual average employment for state and private industry were collected and hand-coded from the Bureau of Labor Statistics's annual bulletin *Employment and Wages Annual Averages* for every state and all years except 1980. One

challenge with regard to these data is that the industry classification system changed from SIC to NAICS in 2001, so caution must be exercised when comparing the data of these two periods. A related, albeit minor problem, is that from 1976 to 1981 data about average weekly wages and number of establishments are only available for major industry groups: SIC-15 general trade contractor, and SIC-17 special trade contractors. Data for the subgroups including electricians, carpenters, masons, roofers, residential construction workers, plumbers, and painters are not available. It should also be mentioned that the BLS definition of an "establishment" as an economic unit that produces goods or provides service and which is usually located at a single physical location and engages in a single economic activity, might be problematic for construction because of the nomadic nature of this industry.

State labor union percentage rates, where the data are for percentages of union members, are available from a website (www.unionstates.com) that is managed by Barry T. Hirsch and David A. Macpherson. These data are for each state and year from 1976 to 2008. The values represent percentages for each state for nonagricultural wage and salary employees who are union members. State unemployment rates (not seasonally adjusted) for each year were collected from the Bureau of Labor Statistics web site http://www.bls.gov/lau/home.htm.

Demographic data for construction and the unemployment rate in construction have been collected by state, year, and occupation from the Current Population Survey-Outgoing Rotation Groups (CPS-ORG), which is part of the Center for Economic and Policy Research http://www.ceprdata.org. The demographic variables of interest are

percentage Hispanic workers by state and year, construction unemployment rate by state and year; average construction worker age by state and year.

Model

The nature of the data in this work (state, year, panel) requires the usage of a lagged Fixed Effect Model to investigate the problem of under-reporting of Hispanics' injuries and illnesses in construction. The model will be lagged 3 years in one of the main independent variables that is the real workers' compensation rate. At the same time the dependent variable (different types of injury rates) is used in the natural logarithm form. The Hausman test will be used to assess the consistency with the Random Effect Model. Grouping over states will also be used to correct for errors and robust models. The model-dependent variable is the different types of injuries, while the independent variables are the demographic variable (age), and labor market variables including real average weekly wage, unemployment rate, state union rate, employees per establishment (firm size), real workers' compensation rate, percentage of Hispanic employees and their interactions.

Panel data (repeated measurement at different points in time on the same individual unit such as firm, state, country) models can capture variation over time and over unit, and there are many different models to accomplish this goal. There will be five different models for each injury type (total injuries, injuries with days away from work, injuries with lost workdays, injuries with no lost workdays, and light duty) as dependent variables, and each will be regressed against the above mentioned independent variables and their interactions.

CHAPTER V

RESULTS

A nested set of three fixed effects regressions were tested against each of five dependent variables measuring five types of injury rates per 100 employees: total annual injuries, injuries resulting in days away from work, injuries resulting in lost workdays (which include both days away from work and light duty work), injuries not resulting in lost workdays, and injuries resulting in light duty work assignments. Table 7 providing descriptive statistics for the variables in each model shows that the mean annual total injury rate was 10.45 injuries per 100 employees. Almost half these injuries resulted in lost workdays (4.99) while somewhat more than half did not (5.56). Because sample sizes vary across models, these two components of total injuries do not sum precisely to the total injury rate. Lost workday injuries divided into injuries resulting in days away from work (4.44 per 100 employees) and injuries resulting in light duty work (0.59 per 100 employees). Lost day injury rates do not measure the days lost from an injury. A lost workdays injury can entail from one lost workday to very many days away from work. Injury rates vary widely in our data from a less than one injury per 100 workers to a high of 35 total injuries in a year per 100 full-time equivalent workers.

While injury rates for particular states and years are for specific subsectors within construction such as roofing contractors, the percent Hispanic is for overall construction

Table 7. Descriptive Statistics

		Model				
		(3)	(6)	(9)	(12)	(15)
Variable	Statistic	Total Injuries	Days Away from Work	Lost Workdays	No Lost Workdays	Light Duty Days
Injury Rate per 100 Employees	mean	10.45	4.44	4.99	5.56	0.59
	standard deviation	5.04	2.58	2.57	3.09	0.58
	minimum	0.50	0.20	0.40	0.20	0.00
	maximum	35.20	19.80	21.00	43.00	7.60
Real Worker Compensation Rate per $100 of Payroll	mean	17.70	17.72	17.69	17.63	17.90
	standard deviation	13.10	13.12	13.10	13.09	13.32
	minimum	2.00	2.00	2.00	2.00	2.00
	maximum	123.03	123.03	123.03	123.03	123.03
Year	mean	1995.93	1995.83	1995.93	1995.75	1995.09
	standard deviation	7.51	7.48	7.51	7.48	7.24
	minimum	1982.00	1982.00	1982.00	1982.00	1982.00
	maximum	2008.00	2008.00	2008.00	2008.00	2008.00
Unionization Rate	mean	13.41	13.45	13.41	13.42	13.38
	standard deviation	6.42	6.41	6.42	6.42	6.37
	minimum	2.30	2.30	2.30	2.30	2.30
	maximum	32.10	32.10	32.10	32.10	32.10
Construction Unemployment Rate	mean	7.99	8.01	7.98	8.01	8.06
	standard deviation	3.77	3.78	3.77	3.79	3.85
	minimum	1.23	1.23	1.23	1.23	1.23
	maximum	23.61	23.61	23.61	23.61	23.61
Real Average Weekly Wage	mean	763.05	762.46	763.17	763.27	757.67
	standard deviation	197.60	197.85	197.68	198.28	197.71
	minimum	44.26	44.26	44.26	44.26	44.26
	maximum	2034.78	2034.78	2034.78	2034.78	2034.78
Employees per Establishment	mean	8.91	8.94	8.91	8.94	8.86
	standard deviation	14.78	14.86	14.79	14.91	13.87
	minimum	0.01	0.01	0.01	0.01	0.01
	maximum	236.90	236.90	236.90	236.90	236.90
Average Construction Worker Age	mean	38.78	38.77	38.78	38.76	38.64
	standard deviation	1.65	1.64	1.65	1.65	1.60
	minimum	33.73	33.73	33.73	33.73	33.73
	maximum	43.58	43.58	43.58	43.58	43.58

Table 7. continued

		Model				
		(3)	(6)	(9)	(12)	(15)
Variable	Statistic	Total Injuries	Days Away from Work	Lost Workdays	No Lost Workdays	Light Duty Days
Percent Hispanic	mean	17.98	17.87	18.01	17.78	17.34
	standard deviation	19.17	19.12	19.21	19.14	19.20
	minimum	0.50	0.50	0.50	0.50	0.50
	maximum	83.70	83.70	83.70	83.70	83.70
(Percent Hispanic)*(Real Worker Compensation Rate)	mean	347.74	346.93	348.07	343.86	345.09
	standard deviation	552.13	553.91	552.34	553.92	566.58
	minimum	2.40	2.40	2.40	2.40	2.40
	maximum	4775.20	4775.20	4775.20	4775.20	4775.20
(Percent Hispanic)*(Unionization Rate)	mean	207.41	206.98	207.59	204.85	196.57
	standard deviation	236.63	236.37	236.68	235.54	228.02
	minimum	4.14	4.14	4.14	4.14	4.14
	maximum	1319.30	1319.30	1319.30	1319.30	1319.30
Observations		3,373	3,336	3,372	3,299	3,097
Groups (State-Construction Subsector)		236	236	236	232	232

within a given state and year. The mean percent-Hispanic is around 18% with a standard deviation of about 19 percentage points. Percent-Hispanic ranges from just 0.5% to over 80%. Construction unionization rates are also for state and year and in our sample average just under 13.5% and ranges from about 2% to over 30%. Real worker compensation rates average about $17.70 per $100 of payroll. This rate ranges widely from just $2.00 to $123 per $100 of payroll reflecting considerable differences in the dangers of different construction activities. Thus, injury rates in construction fluctuate widely, and not surprisingly, so too do worker compensation rates which are based on past reported injuries.

Base Model

In Table 8, the first model reported for each type of injury omits measures of Hispanic workers and predicts various injury rate types based on corresponding worker compensation rates which is lagged 4 years, a year trend plus economic and demographic variables (unionization rate, unemployment rate, real average weekly wage, employees per establishment, and average age). With the exception of light duty injuries, this control model accounts for roughly half of all variation in injuries. Setting aside the light duty model, in these base models, not surprisingly, workers' compensation rates which are based on past reported injury experience negatively predict current injury rates. The year trend in the models is negative reflecting long term trends in strengthened OSHA oversight of construction and enhanced safety practices in construction. Unionization rates negatively predict injuries, reflecting the greater presence of formal training, including safety training, among unionized construction workers. Controlling for unionization, in these base models, real average weekly wages also negatively predict

Table 8. Fixed Effect Regression: Base Model

VARIABLES	lntotcase	lnawayc	lnlostwork	lnnolost	lnliteduty
Real Workers' Compensation Rate	0.00315**	0.00538***	0.00421***	0.00278	0.000319
	(0.00133)	(0.00166)	(0.00152)	(0.00178)	(0.00344)
Real Workers' Compensation Rate Lagged 1 year	0.00155	0.000757	-0.000264	0.00318	-0.00751*
	(0.00164)	(0.00205)	(0.00189)	(0.00221)	(0.00426)
Real Workers' Compensation Rate Lagged 2 Years	2.95e-05	0.000104	0.00157	-0.00111	0.00783*
	(0.00169)	(0.00212)	(0.00195)	(0.00230)	(0.00440)
Real Workers' Compensation Rate Lagged 3 Years	-0.000217	-0.00145	-0.00204	0.000197	0.000861
	(0.00166)	(0.00207)	(0.00191)	(0.00225)	(0.00435)
Real Workers' Compensation Rate Lagged 4 Years	-0.00240*	-0.00392**	-0.00278*	-0.00127	0.00261
	(0.00129)	(0.00161)	(0.00148)	(0.00176)	(0.00340)
Year	-0.0482***	-0.0567***	-0.0436***	-0.0544***	0.0468***
	(0.00156)	(0.00195)	(0.00179)	(0.00210)	(0.00424)
Unionization Rate	-0.0233***	-0.0263***	-0.0227***	-0.0248***	-0.0227**
	(0.00379)	(0.00476)	(0.00436)	(0.00510)	(0.0103)
Construction Unemployment Rate	-0.00893***	-0.00882***	-0.00944***	-0.00966***	-0.00571
	(0.00169)	(0.00211)	(0.00194)	(0.00227)	(0.00446)
Real Average Weekly Wage	-0.000643***	-0.000807***	-0.000617***	-0.000794***	-0.000303
	(7.50e-05)	(9.41e-05)	(8.62e-05)	(0.000101)	(0.000210)
Employees Per Establishment	-0.000728*	-0.000566	0.000128	-0.00156***	-0.00136
	(0.000377)	(0.000469)	(0.000433)	(0.000504)	(0.00101)
Average Construction Worker Age	-0.0219***	-0.00942*	-0.0122**	-0.0299***	-0.0120
	(0.00447)	(0.00558)	(0.00513)	(0.00601)	(0.0119)
Constant	100.1***	115.8***	89.72***	112.2***	-93.28***
	(3.046)	(3.817)	(3.496)	(4.107)	(8.277)
Observations	3,687	3,649	3,685	3,616	3,118
R-squared	0.597	0.557	0.461	0.527	0.229
Number of id_sic3_fip_sq	231	231	231	227	220

Standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

injuries, suggesting that more skilled construction workers generally are safer. We expected larger contractors to be associated with fewer injuries due to economies of scale in introducing safety procedures, but our expectations were met with a statistically significant negative coefficient only in the case of no lost workday injuries. Otherwise, our findings for firm size are statistically insignificant with mixed signs (actually my model shows that injuries with lost work days are statistically insignificant and positively related to firm size). It is generally found that younger workers are at greater risk of injuries in construction, and I also consistently find this across all models.

In the case of light duty injuries where the injured worker is assigned less demanding tasks, our base model predicts only about 23% of the variation in light duty injury rates. In contrast to other injury types, the year trend variable for the light duty injury rate is positive, indicating that the use of light duty assignments has risen over time. (Light duty assignments reduce worker compensation costs by eliminating the need for replacement income payments in lost workday injury cases. They may or may not reflect reduced medical costs.) Furthermore, the workers' compensation rate (lagged 4 years) which powerfully negatively predicts other injury types is statistically insignificant with an opposite sign in the case of light duty work. This opposite sign may be reasonable if higher workers' compensation rates indicate more serious injuries reducing the option of shifting lost workday injuries from days away from work to light duty work. I generally conclude that, with the exception of light duty, my base models reasonably predict injury rates with the expected sign.

Hispanic Effect

In the second model (Table 9) nested within each injury type set of regressions, I introduce the percent Hispanic among construction workers in the state-year to estimate the effect of the presence of Hispanic workers on the reporting of injuries. In all cases, the estimated coefficient is statistically significant at the 1% level. In all of these regressions except light duty, the estimated coefficient for percent Hispanic is negative and statistically significant. For light duty injury rates, the estimated coefficient is positive and statistically significant at less than 10% level. This means that controlling for the aforementioned factors, a higher proportion of Hispanic workers leads to fewer reported injuries along with an increase in the use of light duty assignments for those workers reported injured. The most likely explanation for this last result is that in the presence of more Hispanic workers on the job, injured workers are increasingly assigned to or are willing to accept light duty assignments rather than taking time off work. Based on the second model in each nested set, Table 10 calculates for a one standard deviation change in the percent Hispanic employed what these models predict will be 1) the percentage point change and 2) the percentage change in each type of injury rate evaluated at the mean injury rate. While the predicted percentage point changes vary because the mean injury levels differ, for all injury types except light duty, the models predict between 3 to 8% decline in the rate of reported injuries associated with about a 19 percentage point (one standard deviation) increase in the percent Hispanic. In the case of light duty injury rates, in contrast, a roughly 19 percentage point increase in the percent Hispanic results in a predicted 3.7% increase in the reported injury rate for those assigned light duty work.

Table 9. Fixed Effect Regression: Base Model and Percent Hispanic

VARIABLES	lntotcase	lnawayc	lnlostwork	lnnolost	lnliteduty
Real Workers' Compensation Rate	0.00248*	0.00453***	0.00356**	0.00199	0.000445
	(0.00136)	(0.00172)	(0.00158)	(0.00185)	(0.00352)
Real Workers' Compensation Rate Lagged 1 year	0.00182	0.000782	-0.000161	0.00352	-0.00675
	(0.00168)	(0.00212)	(0.00195)	(0.00229)	(0.00435)
Real Workers' Compensation Rate Lagged 2 Years	-8.36e-05	6.14e-05	0.00163	-0.00130	0.00901**
	(0.00175)	(0.00221)	(0.00204)	(0.00240)	(0.00456)
Real Workers' Compensation Rate Lagged 3 Years	0.000368	-0.000395	-0.00138	0.000734	-0.00102
	(0.00173)	(0.00217)	(0.00200)	(0.00235)	(0.00451)
Real Workers' Compensation Rate Lagged 4 Years	-0.00258*	-0.00422**	-0.00289*	-0.00162	0.00304
	(0.00133)	(0.00168)	(0.00154)	(0.00183)	(0.00350)
Year	-0.0443***	-0.0541***	-0.0422***	-0.0459***	0.0496***
	(0.00201)	(0.00254)	(0.00233)	(0.00273)	(0.00555)
Unionization Rate	-0.0221***	-0.0274***	-0.0230***	-0.0214***	-0.0190*
	(0.00425)	(0.00538)	(0.00493)	(0.00576)	(0.0115)
Construction Unemployment Rate	-0.00730***	-0.00663***	-0.00798***	-0.00671***	-0.00525
	(0.00188)	(0.00236)	(0.00218)	(0.00254)	(0.00496)
Real Average Weekly Wage	-0.000459***	-0.000652***	-0.000474***	-0.000545***	-0.000160
	(8.29e-05)	(0.000105)	(9.60e-05)	(0.000112)	(0.000229)
Employees Per Establishment	-0.000409	-0.000270	0.000285	-0.000965*	-0.00121
	(0.000385)	(0.000483)	(0.000446)	(0.000518)	(0.00103)
Average Construction Worker Age	-0.0222***	-0.00596	-0.00829	-0.0358***	-0.0160
	(0.00491)	(0.00618)	(0.00569)	(0.00666)	(0.0130)
Percent Hispanic	-0.00434***	-0.00392***	-0.00271***	-0.00767***	-0.00178
	(0.000858)	(0.00108)	(0.000993)	(0.00116)	(0.00236)
Constant	92.15***	110.5***	86.74***	95.30***	-98.82***
	(3.951)	(4.991)	(4.575)	(5.363)	(10.90)
Observations	3,300	3,263	3,298	3,230	2,785
R-squared	0.598	0.554	0.458	0.528	0.220
Number of id_sic3_fip_sq	230	230	230	226	219

Standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0$

Table 10. Predicted Change in Injury Rate Due to a One Standard Deviation Change in Percent Hispanic

	Total Injuries	Days Away from Work	Lost Workdays	No Lost Workdays	Light Duty Days
Estimated coefficient for percent Hispanics	-0.004	-0.004	-0.003	-0.008	-0.002
Standard Deviation of coefficient	17.542	17.506	17.531	17.350	17.477
Predicted change in rate with one Standard Deviation change in percent Hispanic	-0.070	-0.070	-0.053	-0.139	-0.035
Mean rate	2.341	1.436	1.563	1.686	-0.906
Mean rate minus predicted change	2.271	1.366	1.483	1.547	-0.941
Percent change in mean rate for 1 Standard Deviation change in percent Hispanic	-3.00%	-4.875%	-5.118%	-8.244%	3.719%

Union and Workers' Compensation Interactions with Hispanic Effect

The full model (Table 11) in each nested set introduces two interaction terms examining the effect of the percent Hispanic in the presence of higher unionization rates and the percent Hispanic in the presence of higher workers' compensation rates. Unions may make construction sites safer but they also may induce a higher reporting of the injuries that do occur. Again setting aside the light duty model, in every other full model, the interaction term between percent Hispanic and unionization yields a positive coefficient which in the case of days away from work injuries is statistically significant at the 1% level. In the case of light duty injuries, the coefficient is negative and statistically insignificant. These results suggest that in the presence of unionized Hispanic workers, injuries are more likely to be reported, particularly serious injuries, and these injuries are less likely to result in light duty assignments. Furthermore, again setting aside the light duty case, once a Hispanic reporting effect is included in the full model, the direct union effect becomes increasingly negative compared to the previous model suggesting that the estimated union effect in the first two models of each set is indeed a composite of increased safety and an offset of increased reporting.

Workers' compensation rates are set based upon past experience with reported injuries. Contractors are motivated to not report injuries when these injuries are more costly to the contractor. Thus, it may be that the under-reporting of injuries associated with the presence of Hispanic workers is more common where workers' compensation rates are higher. Introducing an interaction between percent Hispanic and workers' compensation rates yields negative and statistically insignificant estimated coefficients

Table 11. Fixed Effect Regression: Full Model

VARIABLES	lntotcase	lnawayc	lnlostwork	lnnolost	lnliteduty
Real Workers' Compensation Rate	0.00253*	0.00433**	0.00374**	0.00187	-0.00637*
	(0.00148)	(0.00186)	(0.00171)	(0.00201)	(0.00385)
Real Workers' Compensation Rate Lagged 1 Year	0.00181	0.000603	-0.000193	0.00351	-0.00687
	(0.00169)	(0.00212)	(0.00195)	(0.00229)	(0.00433)
Real Workers' Compensation Rate Lagged 2 Years	-5.29e-05	0.000270	0.00171	-0.00130	0.00785*
	(0.00176)	(0.00221)	(0.00204)	(0.00241)	(0.00456)
Real Workers' Compensation Rate Lagged 3 Years	0.000379	-0.000426	-0.00135	0.000714	-0.00177
	(0.00173)	(0.00217)	(0.00200)	(0.00236)	(0.00450)
Real Workers' Compensation Rate Lagged 4 Years	-0.00257*	-0.00411**	-0.00287*	-0.00162	0.00278
	(0.00133)	(0.00168)	(0.00154)	(0.00183)	(0.00349)
Year	-0.0443***	-0.0546***	-0.0424***	-0.0458***	0.0529***
	(0.00204)	(0.00256)	(0.00236)	(0.00276)	(0.00563)
Unionization Rate	-0.0222***	-0.0284***	-0.0235***	-0.0213***	-0.0130
	(0.00430)	(0.00542)	(0.00498)	(0.00582)	(0.0116)
Construction Unemployment Rate	-0.00729***	-0.00651***	-0.00795***	-0.00671***	-0.00514
	(0.00188)	(0.00236)	(0.00218)	(0.00254)	(0.00494)
Real Average Weekly Wage	-0.000457***	-0.000633***	-0.000471***	-0.000544***	-0.000147
	(8.31e-05)	(0.000105)	(9.62e-05)	(0.000113)	(0.000228)
Employees Per Establishment	-0.000420	-0.000344	0.000257	-0.000961*	-0.000844
	(0.000388)	(0.000485)	(0.000449)	(0.000521)	(0.00103)
Average Construction Worker Age	-0.0222***	-0.00603	-0.00823	-0.0358***	-0.0191
	(0.00492)	(0.00618)	(0.00569)	(0.00666)	(0.0130)
Percent Hispanic Real Workers' Compensation Rate	-0.00453*** (0.00117)	-0.00669*** (0.00148)	-0.00314** (0.00135)	-0.00781*** (0.00159)	-0.00723** (0.00314)
(Percent Hispanic)* (Real Workers' Compensation Rate)	-2.91e-06	1.32e-05	-9.68e-06	6.47e-06	0.000346***
	(3.08e-05)	(3.89e-05)	(3.56e-05)	(4.20e-05)	(8.05e-05)
(Percent Hispanic)*(Unionization Rate)	3.10e-05	0.000324***	7.62e-05	3.94e-06	-7.93e-05
	(9.18e-05)	(0.000116)	(0.000106)	(0.000126)	(0.000261)
Constant	92.30***	111.4***	87.14***	95.22***	-105.3***
	(3.995)	(5.036)	(4.626)	(5.419)	(11.04)
Observations	3,300	3,263	3,298	3,230	2,785
R-squared	0.598	0.556	0.458	0.528	0.226

Table 11. continued

VARIABLES	lntotcase	lnawayc	lnlostwork	lnnolost	lnliteduty
Number of id_sic3_fip_sq	230	230	230	226	219

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

for all injury types except light duty where the coefficient is positive and statistically significant at the 1% level. This suggests that where reporting injuries is more expensive, in the presence of Hispanic workers fewer injuries are reported and injuries are shifted probably from days away from work to light duty assignments. With the introduction of this interaction between percent Hispanic and workers' compensation rates capturing under-reporting and classification shifting, the direct relationship between workers' compensation rates and reported injuries becomes more strongly positive in all but the light duty case, suggesting that workers' compensation rates developed prior to time *t* are more strongly correlated with reported injuries in time *t* when under-reporting associated with the presence of Hispanic workers in time *t* is controlled for.

Table 12 provides predictions of injury rates from the five full models based on mean values for each independent variable (except year, which is set at 2008), and selected one standard deviation changes in variables of interest to an analysis of under-reporting. Column 1 in Table 12 shows a base model of averages (mean) for the independent variable with the corresponding predicted value for each injury type. (The interaction terms are calculated from the assumed values for each term in the interaction). In column 2, the unionization rate has been raised one standard deviation from 13.41 to 19.83. The interaction between the unionization rate and percent Hispanic, which creates a reporting effect in this prediction, has been restricted to the value in the base model.

This allows for an isolation of the union safety effect, without the imposition of a union reporting effect. All predicted injury rates fall (e.g., total injury from 5.20 to 4.00) except light duty which rises from 0.96 to 0.97. Thus, higher unionization leads to fewer injuries with a small shift to light duty injuries.

Table 12. Predicting Injury Rates with Full Model

	Assumed Values for Predictions						
	Base	Increase Union Rate		Increase Hispanic Percent		Increase WC Rate	
		No Union-Hisp Reporting Effect	Union-Hisp Reporting	No Union-Hisp Reporting Effect	Union-Hisp Reporting	No Hispanic-Severity Under-reporting	Hispanic-Severity Under-reporting
Independent variables:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Worker Comp Rate	17.70	17.70	17.70	17.70	17.70	30.80	30.80
Year	2008	2008	2008	2008	2008	2008	2008
Unionization Rate	13.41	19.83	19.83	13.41	13.41	13.41	13.41
Unemployment Rate	7.99	7.99	7.99	7.99	7.99	7.99	7.99
Avg. Weekly Wage	763.05	763.05	763.05	763.05	763.05	763.05	763.05
Employees per Establishment	8.91	8.91	8.91	8.91	8.91	8.91	8.91
Average Age	38.78	38.78	38.78	38.78	38.78	38.78	38.78
Percent Hispanic	17.98	17.98	17.98	37.15	37.15	17.98	17.98
WC*Percent Hispanic	318.28	318.28	318.28	657.65	657.65	318.28	553.85
Unionization Rate*Percent Hispanic	241.18	241.18	356.53	241.18	498.35	241.18	241.18
Dependent Variables:	Predicted Injury Rate						
Total	5.20	4.00	4.18	4.41	4.82	6.15	5.84
Away	1.76	0.93	1.06	1.32	1.59	2.41	2.15
Lost	2.66	1.90	1.96	2.32	2.47	3.23	3.03
No Lost	2.62	2.16	2.26	2.18	2.41	2.97	2.86
Light duty	0.96	0.97	0.91	1.07	0.96	0.83	0.91
Dependent Variables:	Percent Chg. in Prediction when Union-Hispanic or WC-Hispanic Interaction Allowed						
Total			4.5%		9.3%		-5.0%
Away			14.0%		20.5%		-10.8%
Lost			3.2%		6.5%		-6.2%
No Lost			4.6%		10.6%		-3.7%
Light duty			-6.2%		-10.3%		9.6%

However, in column 3 when the countervailing union reporting effect is permitted (by allowing the union-Hispanic interaction term to rise due to an increase in unionization), most injury rates rise somewhat (e.g., total injuries having fallen from 5.20 to 4.00 rise to 4.18) while the predicted light duty injury rate falls to 0.91. The bottom segment in Table 12 shows the rebound in reported injury rates associated with the union-Hispanic reporting effect (e.g., predicted reported total injury rates rebound by 4.5%

when the union-Hispanic reporting effect is permitted). In the case of the most serious type of injuries (days away from work), a one standard deviation increase in unionization (6.5 percentage points) leads to a predicted drop in serious injuries from 1.76 per 100 employees to 0.93 (the safety effect) but when the union-Hispanic reporting effect is permitted, the predicted reported days-away injury rate rises back to 1.06, a 14% increase in reported injuries. This suggests that unions are particularly vigilant regarding more serious injuries.

Furthermore, unions making the workplace safer leads to a slight increase in predicted light duty work (from 0.96 to 0.97), but the union-Hispanic reporting effect deters the shifting of workers from lost workday injuries to light duty (i.e., with the union-Hispanic interaction in play, the predicted light duty injury rate falls to 0.91). Thus, increased unionization rates make the workplace safer and deter the under-reporting of injuries in the presence of Hispanics. But holding the unionization rate constant introduces the question of the effect of an increased percentage of Hispanics.

In column 4, the percent Hispanic has been raised one standard deviation with a corresponding increase in the workers' compensation Hispanic interaction but the union-Hispanic reporting effect has again been restricted to the value in the base model. Thus, under-reporting of injuries due to a one standard deviation increase in percent Hispanic (19 percentage points), but holding the union reporting effect constant, leads to a decline in all injury rates (e.g. predicted total injuries fall from 5.20 to 4.41), except in the case of light duty injuries, which rise from 0.96 to 1.07. However, when the union-Hispanic reporting effect is permitted in column 5, predicted injury rates rebound upwards (e.g., reported total injuries rise from 4.41 to 4.82), except again in the case of light duty, which

falls back to 0.96. In the case of the most serious injuries, the days-away-from-work predicted rate increases by 20.5% (from 1.32 to 1.59), when the union reporting effect is permitted after an assumed 19 percentage point increase in the percent of Hispanic workers. Thus, increasing the percent of Hispanic workers leads to fewer reported injuries and more light duty injuries, but in the presence of unions, this under-reporting due to increased percentage of Hispanic workers is offset by from 6.5% to 20.5% due to the union reporting effect. However, in the case of the predicted light duty injury rate ,which had risen from 0.96 to 1.07 due to a standard deviation increase in the percent Hispanic, allowing the union reporting effect to take hold through the union-Hispanic interaction brings the predicted light duty rate back down to 0.96, the original predicted level in the base model. The model suggests that unions strongly resist assigning more workers to light duty work when the workforce becomes increasingly Hispanic. Thus, the presence of Hispanic workers leads to an under-reporting of injuries while the presence of unions substantially offsets this source of under-reporting.

Injuries are less likely to be reported where workers' compensation costs are high. In column 6, I increase workers' compensation rates by one standard deviation, but I restrict the interaction of workers' compensation with percent Hispanic to the value in the base model. In all cases but light duty injuries, the predicted injury rate rises with higher workers' compensation. However, as column 7 shows, when the interaction between workers' compensation rates and the percent Hispanic is not restricted, these predicted reported injury rates subside somewhat (e.g., predicted total injuries which rise from 5.20 to 6.15 with a standard deviation increase in workers' compensation fall back to 5.84 when the Hispanic under-reporting effect associated with higher workers' compensation

is permitted to take effect). Thus, the presence of Hispanics, in general, leads to under-reporting, and at higher levels of workers' compensation there is a modest additional amount of under-reporting for any given percentage of Hispanic workers.

In sum, higher percentages of Hispanic workers in state construction workforces leads to lower reported injury rates. In general, a 19 percentage point increase in the percent Hispanic (one standard deviation in my data), will lead to a decline in reported injuries of 3 to 8%, across all injury types except light duty which are predicted to rise by 3.7%. However, the presence of unions deters under-reporting as shown in the full models.

CHAPTER VI

SUMMARY AND CONCLUSION

The focus of this dissertation has been an attempt to answer to what extent the presence of Hispanic workers contributes to under-reporting of injuries in the construction industry.

This question hinges on four distinct but interrelated topics: Hispanic workers, under-reporting, injuries, and construction. Previous research and literature has documented each topic separately, and some initiatives have documented two or more of the categories but none have aggregated them. Previous research investigated the under-reporting phenomenon through the lens of reports by national monitoring agencies of workplace safety and injury rates. Such research has generally concluded the presence of the phenomenon and documented the severity in all of the national monitoring systems. Studies of this problem are very recent and very few, even very rare in construction, and specific data for Hispanic workers do not exist. Injury prediction is another well-documented, contentious, and highly-debated topic because of its relation to risk and determining workers' compensation insurance. Prediction of injuries was positively or negatively correlated to workers' compensation. This heated debate over workers' compensation and injuries was behind many reforms and deregulations in workers' compensation laws during the past 2 decades. Many researchers argued that the presence

of higher workers' compensation insurance rates created an increase in the reporting of injuries, where higher benefits increase workers' incentives to report injuries-reporting effect. They have argued that injury numbers are a reflection of a reporting-effect moral hazard and are not real. Contrarily, some researchers argued that higher workers' compensation insurance will increase an employer's incentives to improve safety standards at the work site, decreasing overall injury rates. This is important for the employer because the higher the injury rate, the higher their workers' compensation premium. These premiums are determined by the past history of a given employer's injury rates, using what is known as the experience-rating mechanism.

Another debatable issue in injury determination is the role of unions. Compared to nonunion environments, unions usually enhance workers' bargaining power and provide an institutional framework through which workers' rights are protected. Therefore, we would expect that union workers, with their bargaining power and the plethora of information provided through union channels, will always report any kind of injury occurring during the course of work. We would conclude that under-reporting would be minimized in the case of unionized workers. In contrast, nonunion workers are more vulnerable and more easily manipulated by the employer to not report injuries. This correlates with the fact that such workers are often immigrants and, therefore, legally and linguistically handicapped. These phenomena occur because under the workers' compensation system the employer bears most of the insurance costs and the workers do not. If workers were to bear the cost of their injuries, under-reporting would not be a problem and an employer would not have incentives to not report injuries. Throughout

the literature there is evidence that unionized workers are more willing to report injuries than nonunionized ones simply because they are protected by the institution of the union.

Hispanics are the fastest growing sector of the population, and also the fastest growing percentage in the labor force among minorities. Their growth is especially evident in industries characterized as hazardous, where the nature of the jobs requires less skilled workers, and where work is more physically demanding, such as construction and agriculture among others. Their economic, demographic, and legal status makes them more vulnerable to employer retaliation when reporting any work-related injuries. Given these considerations, we would predict Hispanic workers to suffer from under-reporting, and that is what this research has confirmed. Construction is among the most hazardous occupations in terms of reported fatal and nonfatal injuries.

Based on reports and data published by the Bureau of Labor Statistics (BLS), the trend of fatal and nonfatal injuries has apparently been declining over the past 3 decades. However, for some researchers this decline is fictional and does not reflect the reality of the workplace. This decline can be attributable to numerous factors such as improvement in safety standards, changes in OSHA recordkeeping, deregulation of workers' compensation insurance, under-reporting, and misclassification of injuries. According to BLS officials, the explanation behind this decline is simply an increase in safety standards at the work site, ostensibly due to an increased awareness of OSHA rules and safety regulations. The decline is also due to employers' fears of increased workers' compensation costs resulting from workers suffering higher levels of injuries. This declining trend is very clear for the most serious and dangerous injuries, which require

missing some time from work. For example, there is a 70% decline in construction cases with days away from work between 1976 and 2008. However, injuries with job transfer or restrictions and specifications of light duty work increased by approximately 700% during the same period. This provides a very convincing indication that the declining trend of injuries suggested by the BLS data is not actually due to increased safety, but due to reporting anomalies. Otherwise, why should we observe a sharp increase in injury rates with job transfer or restrictions? Another dubious indicator from the data relates to the question of whether or not the apparent trend may be attributable to increased safety standards, evident in the data for work-related fatalities among Hispanics. There is no doubt that increased safety standards and measures actually facilitated improved safety and reduction in injuries. But, there are other factors which need to be carefully examined to fully explain this trend.

In this dissertation safety was measured by including the year as an independent variable in the basic model to measure OSHA emphasis on safety standards in construction. This trend was significant at the 1% level, and the negative sign means that over time OSHA oversight enhanced safety at the workplace in construction and that it leads to a decrease in all type of injuries except for light duty injuries. Since 1992, the BLS started collecting and publishing data about fatalities in construction and all other industries according to racial and demographic characteristics. We see that overall fatalities declined but construction fatalities have increased since then. Fatalities among Hispanics increased during the same period. This fact casts doubt on the efficacy of

increased safety standards, and simultaneously leads to questions related to why Hispanics are dying at a higher rate in construction when compared to other groups.

To put things into more specific perspective, one can examine the features of the construction industry that shed some light on why under-reporting occurs. According to Philips (2003), the construction industry in the United States has the following defining characteristics: "turbulence, localness, custom production, and the structure of subcontracting in the construction markets" (p.161). The instability and the turbulence characteristic of the construction industry stem from weather and the influence of the business cycle, and changes in the interest rate, even when miniscule, like subtle shifts in the barometer, have large impacts. All these factors contribute to the volatility of the industry in responding to demand. These market dynamics explain the fluctuation in the numbers for employment and unemployment and the high labor turnover common in construction. Construction firms depend on local labor pools, and these reservoirs of labor change with the seasons, as does the demand for labor. At the peak of building season, high demand for labor attracts a workforce both less skilled and younger. Injuries and accidents inevitably increase. Another distinct feature of construction pertains to firm size; many construction firms are considered small in terms of the number of employees. This influences the relation between the worker and the proprietor of the owner of the firm. Other factors include the almost nomadic nature of the business, and the industry's already disproportionate and still increasing reliance on racial and ethnic minorities, such as Hispanics, who are often noncitizens, as their main labor force. Most of the minorities

so employed are legally and linguistically disadvantaged, and their educational levels are often low, all of which subject them to numerous difficulties and potential exploitation.

These facets of the construction industry provide incentive and opportunity for under-reporting of any injury happening in the course of work. Employers know that these conditions favor them, and allow for exploitation of their workforce. Business leaders are tempted with ample enticements to under-report, manipulate, or minimize injury cases. Furthermore, workers are likely to acquiesce to such decisions and practices out of fear of employer retaliation. For some, this might mean losing their jobs. As serious as loss of a job is, others face harsher punishments, including the possibility of deportation for those working illegally. Construction employees may be required not only to labor at their difficult jobs, but to work to obscure or down play their injuries. Added to that, there are bureaucratic obstacles that prevent the reporting of an injury or preclude satisfactory outcomes. There can be no doubt that under-reporting is a key aspect of the construction industry.

From an employer's perspective, under-reporting is an important tool for avoiding the increasing cost of insurance premiums. The fewer injuries reported, the more his company history and past experience will appear to be clean and free of reported injuries—leading to favorable experience-ratings. The data of nonfatal injuries from the BLS with regard to construction show a puzzling trend, one which has to do with the behavior of different types of injuries. What we have seen is that total nonfatal injuries have declined over time, and also that injuries considered dangerous and requiring leave time are also declining, but at the same time, the incidence of less-severe injuries is

rising. Injuries can be deceptively reclassified from very serious to less serious. Employers may manipulate the reporting process to preserve their clean record of few serious injuries and thus maintain their desirable experience-rating. Thus, their workers' compensation rate and this misclassification of injuries may constitute another form of under-reporting. Employers may manipulate injury cases for less-advantaged or disadvantaged workers because of the relative impotence of those employees. Workers may become the victims of under-reporting because of their legal status, the inaccessibility of information about their rights, or language barriers. Unions tend to mitigate many of these abuses, but here again we find that Hispanic workers are at risk. The data suggest that many of the workers—as in the case of foreign-born Hispanics—who are among the most susceptible to being employed in high-risk jobs and the adverse effects of injury under-reporting—do not often enjoy recourse to unions.

Public officials contend that this decline in nonfatal injuries in construction and nearly all other industries owes its success to improved safety standards at the workplace. There is no doubt that safety improved in the construction workplace, but improved safety alone cannot explain the increase of less-severe injuries. If safety has increased, it should decrease all types of injuries across the board. Instead, we have seen a decrease only in the severest injuries, those that require an injured worker to take time off. This factor is very important in determining the future of the company because of its impact on experience-rating and the consequent financial burden when it comes to determining an insurance premium. This is a clear example of a moral hazard from the standpoint of an employer. Misclassified injuries and under-reporting as phenomena would not exist if

workers were responsible for their insurance (and any increases in premiums) when injured. Light duty injury rates are of great value to scholars. They can be used to observe how employers attempt to evade regulations and strive to maintain a clean record by minimizing their reports to national monitoring and reporting systems. Injuries that permit transfers to light duty work are relatively easy to conceal, compared to more serious ones that may be registered through a reporting channel such as OSHA logs or a union.

This research provides different nested models used for different types of injuries, along with a base model to be used as a reference point. The results from the base model are consistent with the previous empirical work that investigated the relation of injury determination. The dependent variable in the base model is total reported injuries and the other four types of injuries, all in the natural logarithm form. Independent variables are demographics and market variables without the Hispanic factor. The year has been used to measure the improvement of safety standards over time. The model predicted that improvement with a negative sign, meaning that over time safety standards improved, and so total injury rates declined. The presence of real workers' compensation proved that employers are very sensitive to increased insurance rates, and so manipulating injuries through under-reporting and/or misclassifying them is to be considered. The regression analysis proved that the higher the workers' compensation rate is, the lower the total injuries, except in case of light duty injuries.

Real average wage in construction and the average age of workers in construction both negatively predicted injury rates. These two variables reflect the idea that the more

experienced (measured in higher wages and higher average age) the worker is, the safer the workplace will be and the smaller the number of injuries will be. The research finding for the influence of firm size on injuries (measured by the employees per establishment variable) was mixed and insignificant. Previous research found that the larger a firm is, the smaller its reported injury rate was. This reflects the idea of an economy of scale, and the higher level of investments of those companies in safety standards.

The main goal of this research is to predict and investigate the influence of the presence of Hispanics in construction on under-reporting. The factor of the percentage of Hispanic workers was introduced to the basic model. As expected, once the Hispanic factor was introduced, it influenced all types of injuries significantly and negatively. This means that as the number of Hispanic workers in construction increased, the rate of reported injuries of all types decreased, except for light duty injuries. The rate of light duty injuries increased, but it was positive and insignificant. The positive sign of light duty means that some types of injuries are reclassified, and injured workers are reassigned to new and less demanding tasks. By reclassifying injuries from dangerous or moderate to light, the employer will guarantee that his workers' compensation premium will not go up. This explanation is centered on the critical factor of increased number of Hispanic workers. Because they may fear losing their jobs, Hispanic workers are more willing to accept transfers to less demanding jobs—and that allows for under-reporting or not reporting any injury.

Another set of models that used the interaction term of percent of Hispanic workers with real workers' compensation rate and unionization rate was introduced.

These models allowed for an investigation into how a higher unionization rate and a higher workers' compensation rate in the presence of a higher percent of Hispanic workers will influence the reporting of all types of injuries.

The model shows that unionized Hispanic workers tend to be the most likely to report their injuries, and the least likely to be reclassified to light duty. The presence of unions in the model shows that the union will provide information and protect its members against any harassment by the employer when they report an injury. The results gave mixed signs for the different injury types, and they were statistically insignificant, except for light duty. Light duty was negatively related and insignificant regarding the interaction term of percent of Hispanic workers and the unionization rate. For the interaction term of percent Hispanics and real workers' compensation rate, light duty injuries were positive and statistically significant at the 5% level.

The preceding chapter explained how workers' compensation rates are determined based on the past experience of a company's accident history—known as the "experience-rating." In this scheme any reported injury is costly to an employer. Employers seek to evade that expense through concealing injuries—sometimes in coerced collusion with employees—through reclassifying an injury or by not reporting it. If there are both Hispanic workers and high workers' compensation rates, we expect any employer to under-report. The last model predicted that the sign of the interaction term of percent of Hispanic workers and workers' compensation rate is negative and statistically significant for all types of injuries, except for light duty where it was positive and significant. This result indicates that under-reporting and reclassification of injuries from

serious to moderate, and from moderate to light, are very common when declaring these injuries is expensive to the employer.

This model can predict how the number of Hispanic workers impacts the behavior of reporting injuries. The model predicts a 3 to 8% decline in all types on injuries when the percentage of Hispanics is increased by about one standard deviation (about 19 percentage points). Reporting light duty assignments will increase by about 3% for the same percentage point increase in Hispanics.

The main question of this research is to what degree does the presence of Hispanic workers contribute to under-reporting. The model predicts and confirms the existence of under-reporting. The findings supported the existence of under-reporting when the percentage of Hispanic workers increases. The prediction is that if Hispanics increase by one standard deviation (19 percentage points), all injury types will decrease, except in case of light duty, and this is a very clear indication of under-reporting. The results suggest that under-reporting will be about 17.9% for all types of injuries (from 5.2 to 4.41 per 100 worker), except for light duty, and under-reporting for the most dangerous jobs (days away from work) will be about 33.3%. At the same time, light duty injuries increase when the percentage of Hispanic workers increased, and this means that injuries have been reclassified. But when the reporting effect is permitted, injury rates rebound upward. For example, total injuries increased from 4.41 to 4.82 per 100 workers. This suggests that unions usually encourage workers to report their injuries, and this increase in injury rate is due to the union reporting effect. This fact is also supported by the increased rate of light duty injuries. So, the presence of Hispanics workers in the

work force will lead to under-reporting of all types of injuries except light duty, while at the same time the presence of unions will mitigate under-reporting when Hispanics increase by resisting any assignment of injured workers to light duty.

The second result predicted by the model concerns the influence of the increased presence of unions (to separate the reporting effect from the safety effect). This will help to separate the reporting effect from the safety effect that unions usually enhance. The literature shows that higher injury rates are usually associated with a higher degree of unionization, and this is known as the reporting effect. This model, in association with a one standard deviation increase in unions, while holding the interaction term of unions and percent Hispanics to the base model, the model predicted that all types of injuries, except light duty, would fall. The increased presence of unions leads to fewer injuries, and this result enhanced the idea of the role of unions in increasing safety at the workplace. If the union Hispanic reporting effect is permitted, total injury rates will rebound by 4.5%, and the rate of serious injuries (requiring days away from work) will increase by 14%. This shows that unions are more scrupulous in ensuring that this type of injury does not go ignored.

Finally, the model also confirmed the hypothesis regarding the workers' compensation rate. If the workers' compensation rate is increased by one standard deviation, predicted injury rates except for light duty increase. However, when the interaction between workers compensation and percent-Hispanic is not restricted to the base model, the injury rate decreased a little. This means that higher workers'

compensation rates in the presence of a higher percentage of Hispanics exacerbate the problem of under-reporting, because of the higher financial cost.

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